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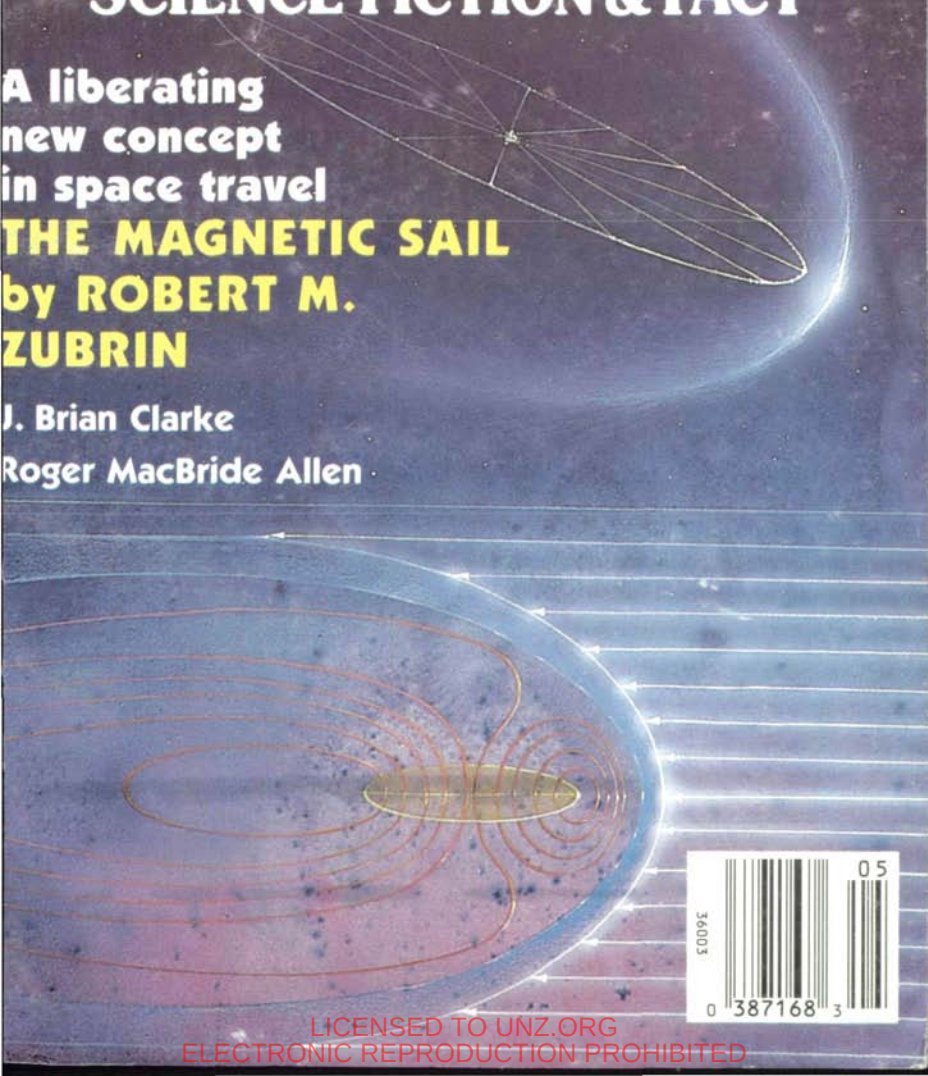

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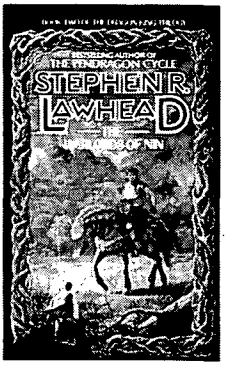

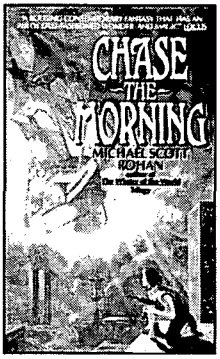

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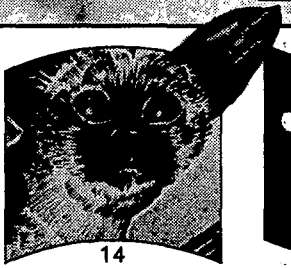

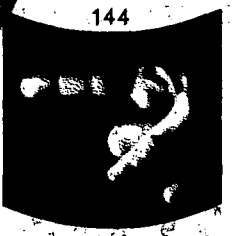

Vol. CXII No. 6
May 1992

Next issue on sale
April 28, 1992

Serial

THE MODULAR MAN, (Conclusion), Roger MacBride Allen ____ 92

Novelettes

ADOPTION, J. Brian Clarke ____ 14
THE FUNDAMENTAL RIGHT, Doug Larsen ____ 144

Science Fact

THE MAGNETIC SAIL, Robert M. Zubrin ____ 58

Short Story

THE GOLDEN LIFE, Pete D. Manison ____ 76

Probability Zero

SELF-LIMITING, Dr. Robert L. Forward ____ 90

Reader's Departments

THE EDITOR'S PAGE ____ 4
THE ALTERNATE VIEW, John G. Cramer ____ 138
IN TIMES TO COME ____ 143
THE REFERENCE LIBRARY, Tom Easton ____ 161
BRASS TACKS ____ 169
THE ANALOG CALENDAR OF UPCOMING EVENTS ____ 176

Cover for "The Magnetic Sail" by Robert Murray

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Indicia on Page 5

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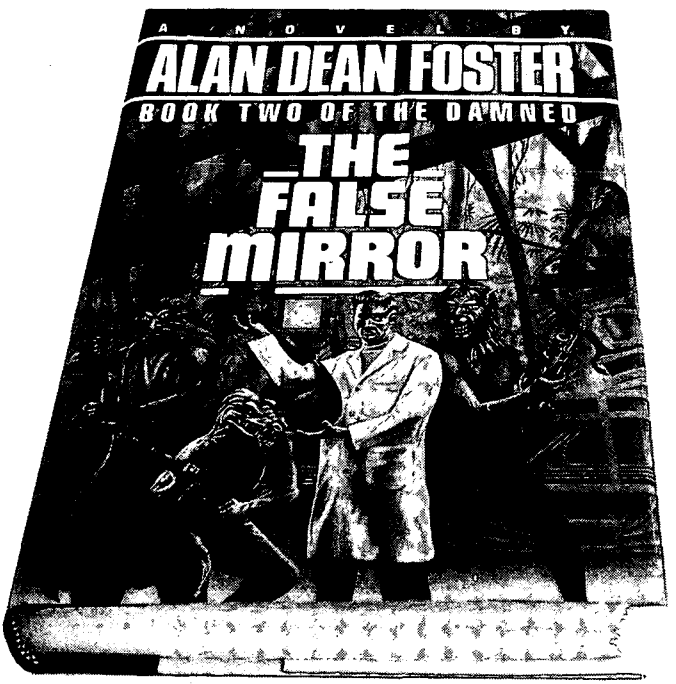

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Editorial

EDUCATION FOR CHANGE

Stanley Schmidt

Somebody once said (and has since been quoted so often that it's difficult to recall the original source or exact wording) that the only way new scientific ideas ever get accepted is for the old scientists to die off and let young ones take their place. There's an important corollary, of course: the young ones have to be exposed to the new ideas, so they'll know what they are and can incorporate them into their thinking. That happens through publication in journals, cocktail party conversation at professional meetings, and so forth. It's not enough to make the new ideas part of the generally accepted body of knowledge, though, because too much respect has accreted around old scientists with too much vested interest in old ideas to embrace new ones. Only when they are gone, and similar respect begins to attach itself to the young whippersnappers pushing new notions, will a paradigm shift get through to a whole profession.

A similar process probably tends to apply to *any* society-wide change in ways of thinking or doing. Consider, for example, the persistently cantankerous refusal of the United States to do anything serious about adopting metric measurements. Yes, I know that steps have been officially and nominally taken; but in practice, almost all measurements in everyday life in this country are still done in clumsy old English units. That's true almost nowhere else in the world.

I've never heard anybody make a co-

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gent argument that English units have any intrinsic advantages over metric ones. Anybody who's worked with both knows that a system in which all internal conversion factors are simple powers of ten is *much* easier to handle than one in which they include 2, 4, 12, 16, 16.5, 36, 144, 1728, and 5280—among many others.

Furthermore, being one of the very few countries that still doesn't use metric units routinely puts this country's citizens at an immediate disadvantage when they travel almost anywhere else in the world. We've all heard Americans return from trips abroad grumbling about the difficulty of knowing how much they were really paying for fuel or food or fabric. Ironically, they often seem to think this is the fault of other countries for being too pig-headed to use our (stupid) units. When was the last time you heard such an American complaining about the failure of his own schools to prepare him to deal with the rest of the world (much less blame *himself* for not learning anyway)?

So why are Americans, almost alone, still mired in feet and yards and similar encumbrances? In keeping with my opening remarks about the generation attached to old ideas making room for a new one not so attached, we might expect a similar process to be required for metrics to become established here. Most adults simply don't feel sufficient motivation to learn something new, even if you explain to them why it's easier and better than the old. This isn't surprising; they already *know* the old system, so even learning an easier one requires additional effort that they don't want to be bothered with. Many of them feel so strongly about this that they won't even listen carefully if you try to tell them why metrics are easier. Because the new system is unfamiliar, they actually believe it's harder.

So if you want the country to go metric, forget about the adults. Too many of them are lost causes; you'll *never* convert them. What you need to do is get *children* to grow up comfortable with metric units. Then, when they grow up and take their parents' places and start running the country, you'll find that they don't want to be bothered with the complications of English units, and virtually everything will be done metrically.

Oh, yeah? So why hasn't it happened? Haven't the schools been teaching metric units for at least a couple of decades? Where's the generation of kids who feel right at home with them? Why do even many children still believe that

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metrics are hard?

Partly, of course, because they hear their parents say so, and they tend to believe them. (Parents and elementary teachers take note: you wield more power than you may realize. Kids *will* learn things from you, but not necessarily the ones you want them to—or the ones they should!) But there's another reason why metric teaching has not "taken." The schools, or at least many of them, are going about it the wrong way.

How *should* they do it? Well, consider another area in which the process *is* working. In the last couple of decades, personal computers have become a pervasive part of everyday life, at work, at home, and at school. Many adults are still scared to death of them and resist having anything to do with them, even though many are far easier to use than they used to be. On the other hand, a new generation is growing up considering computers as normal a part of the environment as rocking chairs.

More than half of American school children now use computers, and most of the ones I've talked to consider them fun—even though many of the computers in schools are unnecessarily difficult to use. I suspect that the actual percentage of children using computers is much higher than that, since things like Nintendo games are actually quite sophisticated computer systems—and an *extremely* popular pastime among school-age children. Probably some kids don't realize that what they're playing with is a computer, but many do. I've heard

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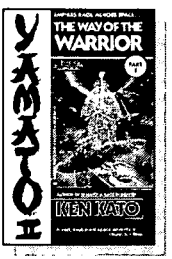
A WORD FROM BRIAN THOMSEN

One of my favorite books has always been Mark Twain's *A Connecticut Yankee in King Arthur's Court*, where Twain's 19th Century man of science passes himself off as a magician through trickery and science....But what if magic really *did* work? Could his hero survive? Simon Hawke has taken Twain's basic premise using a modern man of science and providing just that sort of magical twist. What results is more fun than "Rocky and Bullwinkle" reruns, where an evil magician battles an absent-minded professor, where magic meets science, and a good time is had by all.

...And when you see me around, ask me how Greg Bear can possibly follow up the destruction of Earth (which is exactly what he does in *Anvil of Stars*).

ALSO THIS MONTH:



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ten-year-olds talk casually and knowledgeably about why the new Nintendo system is better than the old, in much the same language that its designers use among themselves.

So why is a new generation growing up comfortable with computers? Because they've had a chance to play with them! They've had hands-on contact, sitting down with a keyboard or joystick and monitor to try things out and see what they can do. Part of their experience has been guided, but part of it—maybe even the most important part—has been simply trying things out and discovering for themselves that they can do things that are both useful and fun, and that they can't do any other way. It has built-in rewards, and those encourage them to do more of the same.

Prediction: when this generation grows up, they are going to incorporate computers into even more aspects of their lives than we have, and will see nothing extraordinary about that fact. I won't be surprised, for instance, if in the not-very-distant future this magazine and all others, as well as books, come to you not on paper but on a tiny disk that you slip into a handheld reader the size and shape of a paperback book. Ben Bova called them "cyberbooks" in his novel of the same name (which I suspect got published just barely in time to be called "prophetic").

I've been astounded at the number of people, even people working with science fiction, I've heard shrug off the cyberbook concept as one that will never really amount to anything. Tom Easton, elsewhere in this issue, puts his finger on one of the reasons why that may be true in the very short term: " . . . most people seem to prefer to kick back with a paper book—its feel and heft and smell familiar since childhood . . . " The last three words there, I think, are crucial. Adults, except those who are still young and flexible, very probably *will* resist cyberbooks for just that reason. But a kid who grows up spending a lot of time crouching over a flickering screen and keyboard, and seeing magical things happen there, will grow up with the same kind of pleasant associations for screens and keyboards that her parents had for paper books. If her education comes more from computers than from books, in fact, the heft and smell of paper may mean very little to her.

That thought appalls some adults, of course, but not me. I don't have any sentimental attachment to clay tablets or papyrus scrolls, either, though I'm sure some of my ancestors did. The information stored on tablets or scrolls or printed pages or diskettes is far more important than the storage medium, and I'm not at all disturbed by the thought of a new generation adopting new media because they have advantages over old ones. It seems, actually, quite a reasonable thing to do.

Meanwhile, back at the metric system . . . . Most of the programs I've seen for teaching it have had the same serious flaw as many language courses: they teach the new system not as something which is directly useful in its own right (like a computer) but as something which *has to be translated into some-*

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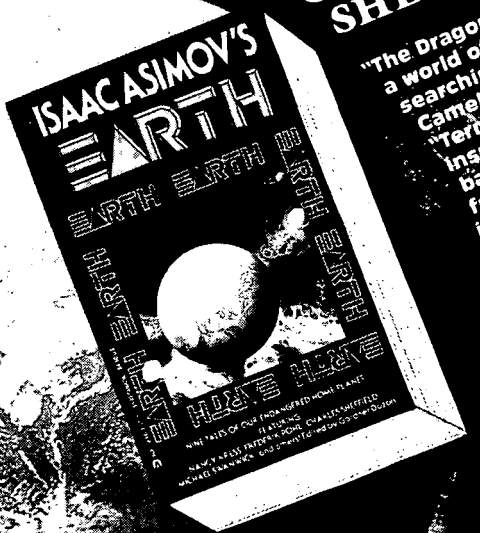

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thing else to be understood and used. This is nonsense. Nobody who really *uses* the metric system *ever* converts meters into inches to see what they mean, any more than a Frenchman translates his girlfriend's words into English to understand what she's saying—or a Nintendo player writes every step of a game down with pencil on pad. Yet schools persist in spending a great deal of time teaching hideous conversions like 1 in = 2.54 cm and 1 m = 39.37 in = 3.28 ft.

No wonder kids resist metric, when it's taught that way! The conversion factors *between* systems are even worse than the ones within the English system. *And they're completely useless and unnecessary in a metric society.* There's no good reason to teach them at all; for the extremely rare cases in which they're needed, you tell the kids where they can look them up. Then you can get on with the business of really teaching *metrics*, not as an arcane curiosity to be understood through a more complicated intermediary, but as a highly practical tool that needs no outside help to be useful.

A person who grows up in a metric society grows up with a mental image of what each unit looks and feels like. A centimeter is about "this long," and he can show you by holding up a thumb and forefinger, just as an American can show you an inch. A kilogram is about the heft of a moderate-sized hardcover book. And so on.

That's how you teach metric. Forget about converting inches to meters or pounds to kilograms. Start in kindergarten and just leave a bunch of objects around the classroom where the kids can pick them up, handle them, and play with them—things that just happen to be labeled with their measurements and masses in metric units *only*. When they start measuring things, give them metric rulers and scales—with no English units on the other side. When they start doing word problems, give them data in metric units, have them find answers in metric units, and then talk them through comparisons with familiar things to make sure they're *picturing* what the answers mean.

Do that for ten years, all over the country, and you'll see an emerging generation of young adults who are so comfortable with metric units that they're unwilling to be bothered with English anymore. That fact will be increasingly reflected in how they do business and make laws, and pretty soon you'll have a country that remembers English units as a quaint artifact, but actually *functions* in metric—and whose citizens can communicate easily with those of any other. It won't happen overnight, but it will happen more surely than with anything we've tried yet.

What about English units in the meantime? Teach them concurrently, if you must, but with no conversion *between* systems, and with no more emphasis than necessary. Bear in mind that you can greatly reduce the extent to which it's necessary by requiring all product labels to carry both kinds of units for the first few years—English for the oldtimers who won't learn, and

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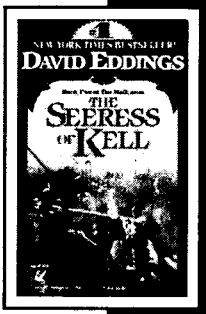

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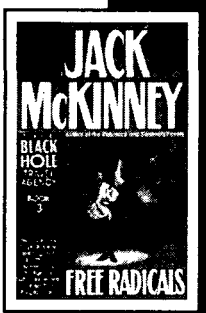

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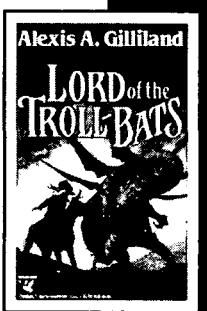

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metric for the kids. This is already done to some extent, but not utilized as well as it could be. I offer one such product to start the ball rolling: thanks to the two liter soft drink bottle, most kids now do have a feel for what "two liters" means. It's not much, but it is a start. And if each year we make the metric label a little bigger, and the English a little smaller. . . .

Who knows? Eventually, maybe even adults *will* learn!

In a sense, of course, this whole program would be just a start. In a world as rapidly changing as ours, computers and metric units are just two examples of ways that we're going to have to train whole generations to new ways of thinking and doing. Even if you don't see any particular importance in metrics *per se*, it might be a good test case to start learning how to do that special kind of teaching: what works, what doesn't, and how to make the whole process as painless as possible for both old and young. ■

●Growing old is no more than a bad habit a busy person has no time to form.

André Maurois

●The only thing to do with good advice is to pass it on. It is never of any use to oneself.

Oscar Wilde

●Fanaticism consists in redoubling your efforts when you have forgotten your aim.

George Santayana

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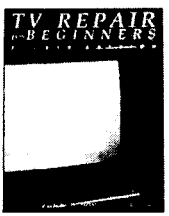

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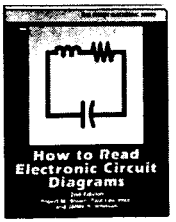

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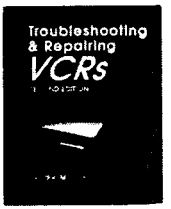

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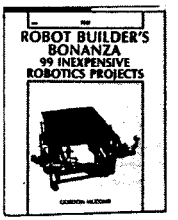

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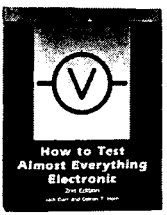

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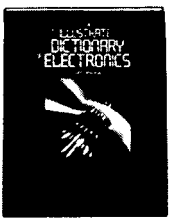

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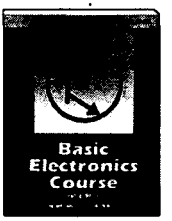

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It had been a rough landing. But not, fortunately, a fatal one.

One by one they had clambered or been dragged through a rent in the shuttle's crumpled hull. A few nursed sprains, a couple were still coughing from leaking fuel fumes, and one sat unsteadily on a boulder as the medic worked on a gash in her forehead. Another, who held together the fragments of a tunic which had been ripped from collar to hem, was still bemusedly wondering what miracle had prevented the jagged metal from penetrating her flesh. The rest of the crew simply sprawled on the ground under the warm light of Alpha Centauri A.

Captain Emmaline Bonderhame limped across to the first officer. "Any ideas?"

"About our location, you mean?"

"It's a good place to start."

Jan Kraska shaded her eyes. A lanky, dark-haired woman with more than a hint of Amerind ancestry in her fine-boned features, she pointed down the valley, toward where rolling country faded into the haze of distance. "Well, I can only tell you that if help does not come our way pretty damn quick, someone is faced with a walk of five or six hundred klicks in that direction."

"What about the radios?"

"Useless. Whatever it was rendered all our electronics into so much junk."

The captain grimaced. *Whateveritwas*. As good a description as any for the bright flash which had transformed their complex aero-space machine into a flying brick. "So I guess we walk, huh?"

Jan glanced pointedly at the other's leg. "Some of us anyway."

"Don't rub it in, dear." The captain limped back to the shuttle. "All right everyone. Council of war!"

Slowly, they gathered around. They were twelve women who, even at this moment, were supposed to be somewhere over the horizon of Genser's World, being welcomed into the tiny and mostly male community of Curtis —a gender preponderance determined during the so-called "God" decade, when space funding had been subject to the edicts of a House of Assembly dominated by the fanatical chauvinism of a cabal of Moslem-Christian fundamentalists. Fortunately the silly years had gone the way of all political aberrations, after which Earth's chastened legislators quickly found the political will to refund the Amazon Project.

And now—?

Well, it was fortunate for them that Emmaline's inspired piloting had accomplished what most experts would probably have insisted as impossible; bringing the crippled shuttle down through a turbulent atmosphere to a survivable landing on the totally unfamiliar surface of an alien world. It had been old-fashioned seat-of-the-pants flying, without power and without instruments.

Amazon's Child would certainly never return to space, or even the air, again. But those who had ridden her down from orbit, from the now empty starship *Amazon One*, were by the grace of Emma and God (in that order), still alive.

And it was not a bad world on which to be alive, even if misfortune had slightly misdirected their point of landing. The weather was currently benign—which was not unexpected, con-

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sidering the careful planning which had allowed for the decades-long and sometimes extreme meteorological cycles of this planet of a multiple star system. Nevertheless, it was entirely fortuitous that the final resting place of the shuttle was a pleasant meadow between wooded hills. A few meters away, a lively stream frothed and danced toward some distant ocean. In one direction, beyond the hills, a range of precipitous peaks reared their spectacular summits against a bright, crystal sky. In the other direction, the valley dropped toward a distant, cloud-dappled plain. A couple of hundred years ago, Earth had had places like this. Perhaps even the air had smelled as sweet.

"First the good news," the captain said. "We are on the right planet."

There was a ripple of nervous laughter. "You mean there is bad news?" Greta Harpson, geologist, one arm in a sling, used her uninjured arm to gesture expansively at their surroundings. "I thought we were here for a picnic!"

"Speak for yourself," someone muttered. "I only came here to get a man." This time, the laughter was genuine.

Emma forced a strained smile. "Well, the men are on the planet all right—maybe six hundred klicks from here."

"Won't they be looking for us?"

"I am sure they will try. The problem is, what happened was so sudden we had no chance to transmit a mayday. As far as the people in Curtis are concerned, we disappeared over a wilderness which could lose an army. Sure, they have a couple of functioning helos. But even that advantage becomes somewhat blunted when you are faced with an area of search which covers a thousand klicks."

"But we know where Curtis is from here, don't we?"

"More or less."

One of the women stood up. Christine Stadderfoss, the Amazon Project's agronomist and temporary supply officer, was deceptively slight with a close-cropped head of white-blond hair. "Captain, who goes for help?"

Emma shrugged. "About half of us are obviously in no shape for an extended walkathon. So us cripples stay, while the rest of you go."

"May I point out that we have only enough food aboard the *Child* to keep us all going, on reduced rations, for a couple of weeks at the most?"

"Which is about as long as it will take to get to Curtis. So what is the problem?"

"Only that the walkers will have to average forty or fifty klicks per day across territory of unknown difficulty. Even for people in top condition, that is a lot of hiking."

"What is your point?"

"Because they have to keep moving, the walkers cannot afford to take risks with local fish, berries, or whatever. On the other hand, those who stay may have to. So cut the walking party down to a minimum, say of three people, and make damn sure they carry enough Earth food for the entire trip. The rest will have to take their chances."

"Bit brutal, isn't it?"

"I don't like it either," the agronomist retorted. "But has anyone a better idea?"

There was a brief silence as everyone began to realize the desperate lack of

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alternatives. "What do we know about what we can eat around here?" Su-Lan McLaughton asked. The physicist's Irish brogue was disconcertingly inappropriate to her slender, almond-eyed looks.

A hand was raised. "I am reasonably familiar with Howard Scheckart's notes as well as his paintings," Ella Shire offered, referring to the work of the botanist/artist who had been with the first expedition to Genser's World. "I think I can identify some of the edibles."

Emmaline looked across at the red-haired bacteriologist. "What are the odds?"

"I will tell you after I have had a couple of hours to look around."

"All right, you have it. Starting now."

As Shire scrambled to her feet and headed toward the thicker vegetation at the stream's edge, the captain asked, "Does anyone else have something constructive to offer?"

"Only that the walkers should be on their way ASAP," Stadderfoss insisted.

"I agree," Jan Kraska said quietly.

The captain sighed as she looked at her first officer. She suspected what was coming. "Spit it out, Jan."

"It's the wild card in our equation—that we are not in this mess by accident."

"So you believe that flash—?"

"*It is more than belief, Emma. I know* we were shot down."

Jan Kraska, Christine Stadderfoss, and Delsa Crawley started at dawn the next day. Crawley, the Amazon Project's wiry and intense planetologist, became the obvious third member of the team when she reminded the selection committee (composed of the captain and the first officer) that she was one of the exclusive sisterhood of Australian women who had stood on the summit of Mount Everest.

Clouds had moved in overnight and a thin drizzle was falling as the three started down the valley. Their packs were heavy and their footwear, although sturdy, was designed for lighter duty. Nevertheless, the first few hours passed almost pleasantly. The sun came out, and the landscape literally sparkled as the light danced off dripping trees and vegetation.

"I don't envy them back there," Delsa commented during their first rest. "I mean how would you two feel if you were hungry, and were surrounded with luscious looking fruit that you cannot touch because it might be poisonous?"

Jan grimaced. "Don't be so sure we won't be faced with that dilemma before we are finished." She picked a wrinkled yellow berry from a ground-hugging plant, put it cautiously in her mouth and almost instantly spat it out. "Ugh! Bitter as hell."

"So why—?"

"Because according to Ella, this is about the only fruit she is certain will not hurt us. Although Howard Scheckart called it the 'yellow peril' because of its lousy taste, it apparently has nourishment value for humans."

Christine looked sourly at the few ugly globules of yellow on the plant. "I hope we don't get that hungry. Even if those things tasted good, you'd need a dozen just for a mouthful."

Jan continued cheerfully, "Don't worry, there are other goodies. For in-

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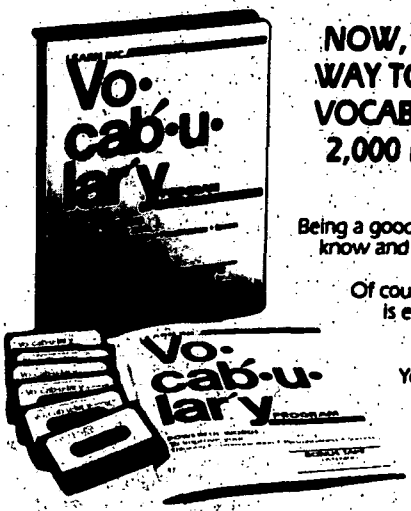

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stance, there is a fairly common fish which looks like a green lamprey. It's scrawny, and there is not much meat on it. It also tastes horrible—that is, according to Scheckart according to Ella, who in turn told me it has a flavor like long-dead carrion. But it is edible protein."

"So what are we supposed to avoid?" Delsa asked as they resumed trudging across a flower-speckled slope.

"Then again, Ella could only remember a few obvious ones. There is something which looks like a small orange, another a green grape, and a third which vaguely resembles a coconut. Oh, and watch out for a cuddly little critter which could be a chipmunk, except it has a bite which can kill within seconds."

"In other words, if it looks good leave it alone." Christine stamped a boot and a buzzing flurry of the local equivalent of insects rose around her legs, whirled, and almost instantly settled again. "My god, there are even gnats!"

Delsa looked uneasily at the surfeit of decorative blossoms which painted the landscape. They were mostly crimson, with clusters of blue and gold. "Where I come from, flowers attract insects." She plucked one of the tiny creatures from her pant leg and held it against the light. "And some have stings!"

"We have anti-venom," Jan pointed out.

"Against what? Honey bees?"

Nevertheless, by the time they stopped to make camp, no one could claim even the equivalent of a mosquito bite. If much of the natural food of this world was anathema to humans, so were humans apparently anathema to much of the local biting life. One flying life form, hawk-sized and feathered, although the head vaguely resembled that of a siamese kitten, frequently flew low over the women in groups of up to a dozen individuals. Although their high-pitched meowing was raucous and irritating, their constant presence seemed more the product of curiosity than of threat. And the antics of the smaller ones as they looped, dove, and squeaked at each other and their human audience, was almost endearing.

As the sun settled lower over the mountains, the landscape took on a glow which was incomparable to anything any of the three had seen on the planet of their birth. With its unearthly beauty, this alien evening triggered a sudden homesickness for the more familiar sights and smells of home—for dusty red sunsets reflecting a thousand patterns of lurid light from the glass and steel towers of great cities, for the sterile yet comforting taste of artificially cleansed and filtered air.

One group of what the three women had dubbed "catbirds," settled into a tree within viewing distance of the camp fire, and watched these strange two-legged creatures from enormous eyes that reflected the firelight like small pairs of fog lamps. The meowing had softened to a gentle warbling which lightened the depressed mood of the women like a psychic balm.

"I wonder—" Christine rose from her place by the fire and walked slowly toward the tree. The others watched as she squatted down and held out an arm. Her soft call was incongruous. "Come

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here, pussy. Puss, puss . . .''

Two of the smaller catbirds abruptly dropped from their perch and, with broad wings extended, landed neatly side by side on her arm. As they warbled and mewed, the agronomist stood erect and walked carefully back toward her companions. By the time she reached them, one of the animals had climbed to her shoulder while the other remained firmly on her forearm. ''Aren't they beautiful?'' she crooned.

Jan and Delsa met a reflection of their own curiosity as the two creatures returned their stare without the least sign of fear. The black and brown wings and body of each catbird were feathered, with the feathers becoming almost indistinguishable from fur around the neck and head. The wings were extensions of the fingered forelimbs like those of an earthly bat. A single hindfoot with long, slender toes extended below the broad tail, and trumpetlike ears twitched in reaction to the whispered human conversation. The faces were indeed catlike, with huge eyes which suggested adaptation for night vision, although so far the creatures had not seemed nocturnal. Christine used a finger to delicately stroke the striped furry head of the catbird on her forearm, causing it to warble with pleasure.

Making cooing noises, Jan reached out and enticed the second catbird from the other woman's shoulder onto her own forearm. Within seconds, she had her acquisition warbling with equal enthusiasm.

''Why are we doing this?'' Delsa asked as she reached out and added her own finger to Christine's caress. ''I mean, considering what we have already been told about the chipmunk creatures—''

''Good question,'' Jan replied equitably as she lifted her arm and a soft little head nuzzled her cheek. ''Are we idiots or what?''

''I don't think Ella was talking about catbirds, which she did not mention anyway. But you never know—'' Christine sat down heavily, causing her catbird to meow with protest. ''What *have* these creatures done to us?''

There was a squawking cry from the tree, which the two young catbirds answered with reluctant squeaks and then began bobbing up and down as if they were ready to fly but not quite sure if they needed to. The summons was repeated, and this time both youngsters spread their wings and flew back to join their elders. As the fire died and the women prepared for sleep, the concerted warbling gradually faded to inaudibility. Two-by-two, the small foglamps began to blink out.

''Sleep well, little friends,'' Christine murmured drowsily.

There was an answering warmth—

When they woke the next morning, the catbirds were gone. But there was a neat line of grey-green nuts on the ground below the tree in which the creatures had roosted. The line pointed directly in the direction of a large bush a dozen or so paces away. Jan picked up one of the nuts, examined it, and then walked across to the bush. It was covered with hundreds of the gray-green spheroids. ''Are the catbirds telling us these things are good to eat?'' she wondered aloud.

She plucked a nut directly from the

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bush and pried the shell apart. Inside, there was a soft substance with the color and texture of banana flesh. She scooped out some of the substance with her finger tip, sniffed it, then popped it into her mouth.

Horrified, Christine shouted, "Don't eat it!"

Jan merely smiled, then swallowed. "Bland," she said after a moment.

As their companion walked back, Christine and Delsa watched with concern. "How do you feel?" Delsa asked anxiously.

Jan grinned. "Like I have just swallowed a mouthful of cyanide. Come on, lighten up!"

Nevertheless, as they resumed their journey, the women were uncomfortably aware that instead of acting as scientists with many combined years of discipline and experience, they had behaved like immature schoolgirls who had found a couple of friendly kittens. The fact that no harm had come from the encounter; either from the catbirds or from the fruit which Jan had tasted, did not reduce the enormity of their lapse from the rules.

It was Delsa who finally bit the bullet. "They made us do it!"

Jan blinked. "Ah—I beg your pardon?" They had reached the plain, where the mountain stream had widened into a shallow river which undulated toward the distant coast. The local equivalent of prairie grass grew in oddly spaced hummocks, with something like a springy moss in between. It remained easy going, even as they traversed between the loops of the river. And when it was occasionally necessary to wade across, the water was rarely above their knees. The trees were widely scattered, reminding Jan of what the savannas of Africa had once been.

"Well it's obvious, isn't it? Dammit, if I had never seen or heard of a kitten before, I would have kicked the little bugger to hell and back before I let it touch me. On a strange world with unknown hazards, you do not cuddle something just 'cause it's cute!"

Christine wearily dropped to a boulder and extended her aching legs. "Delsa, are you suggesting the beasts used some kind of mind control on us?"

The planetologist snorted. "If the shoe fits—" She lowered herself to the ground and supported herself on outstretched hands. "It's a pretty useful defense, right? I mean, if you can persuade a carnivore that you are too lovable to become his dinner."

"Except for the problem of Occam's razor," Jan said.

"Huh?"

"Nature is always logical. What would be the need to evolve the complexity of mind control, if you already have good ears and wings?"

"In that case, try this on for size." Delsa leaned forward and whispered conspiratorially, "The catbirds are someone's pets."

The suggestion was so outrageous, neither of Delsa's audience bothered to laugh. Instead, "Pets?" Jan echoed. She sighed and rolled her eyes upward. "Where do they get these ideas?"

"Whose pets?" Christine wondered aloud.

"Who knows?" Although Delsa had started the game, the Australian had the uncomfortable feeling it was not so easily finished. "The way the catbirds took

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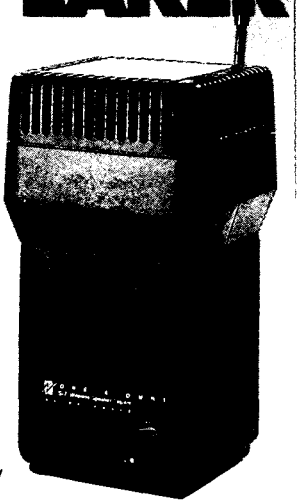

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to us, I imagine their owners are not so different from us."

"The colony at Curtis—"

"No." Delsa shook her head. "We would have been informed of the catbirds' existence. In any case, if the beasts are from there, how come we found them so far from home?"

Christine said thoughtfully, "You got that wrong. They found us."

Jan shook her head with disbelief. "I wish you two could listen to yourselves. You're like kids telling each other bedtime stories." Again, she addressed the sky. "*Owners*, for chrisake!"

The former first officer of *Amazon One* had always prided herself on being a pragmatist. She scoffed at those who looked for ghosts in so-called "haunted" houses, and shuddered at the never-ending flood of theorists who used pseudo-science to insist that Earth had been visited by intelligent beings in the past. She had even gained modest notoriety as one of a group of multi-disciplinary activists who used the media to debunk explanations which relied on other than hard scientific argument.

Which was why the shaking Jan Kraska had received when *Amazon's Child* came down was more psychological than physical. The flash of unknown radiation which had disabled the shuttle's electronics, which obviously could not have originated from Genser's human colony, had unnerved her to the extent she now realized her reaction to Delsa's half playful, half tentative theory was premature at least, and certainly unreasonable. It was enough to make her wonder if there was a closet Luddite lurking somewhere in her subconscious.

It was also the beginning of a new and healthier attitude which was soon put to the test.

They had been traveling for six days. They were approaching the point in their journey where Jan figured they would have to cut north from the river, toward the coastal lowlands and hopefully their ultimate destination at a cluster of dwellings called Curtis. To their right, an isolated range of hills dominated the prairie landscape. Ahead, the plain rolled on toward its distant horizon; a continuous and monotonous vista of undulating terrain that seemed as infinite as the sky itself.

"It's too bloody easy," Delsa commented during their noonday rest. "Dammit, I had at least anticipated a herd of stampeding buffalo or something. Or a chasm to cross." She became wistful. "Or a mountain to climb."

Christine chuckled. "This is not the North American Midwest, you know; which in any case has not seen wild buffalo for centuries. And I hate to add to your misery by reminding you that Genser's biggest land animal is a solitary wanderer about the size of an antelope—"

"—only according to First Expedition reports," Delsa interrupted. "You are forgetting this is a big world. What we know of it, is only prologue."

"To the volume our kids will write?" Jan smiled. "Delsa, if that mountaineer inside you is still struggling to get out, then I suggest that after we get to Curtis you persuade Victor Kraskinn to take you to that land fault he discovered. I bet he would enjoy watching you at-

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tempt to climb three thousand meters of vertical rock face."

"I would be quite content to rappel down it, thank you very much," Delsa rejoined calmly. "In any case—" Her down-under twang trailed into silence as she stared toward the hills. "Say, did either of you see that?"

The gleam she had seen, which had faded, suddenly returned. It was a brilliant point near the summit of one of the hills.

"I see it, I see it!" Jan exclaimed as Delsa grabbed her arm. Jan glanced up at the sun, which had appeared from behind high drifting clouds, then back at the hills. "It has to be a reflection of some kind."

"Off what? Nothing short of a mirror can reflect light like that."

Slowly, as the sun moved, the gleam faded. Then it was gone. Overhead, a large group of flying creatures flapped leisurely toward the hills. Some meowed companionably as they passed over, although none of the catbirds descended.

"Do you think they are ours?" Christine wondered with a strange, almost intense yearning.

Delsa said eagerly, "Look, we have to cut north anyway. Right? So let's do it from here! A side trip won't hurt us, and it does look as if the catbirds live in that direction."

"What is our supply situation?" Jan asked.

"A little better than expected," Christine replied. "We are ahead of schedule, after all. And we do have a few of those nuts."

Delsa suggested, "Perhaps if we split up—"

"No way!" Jan said firmly. She looked doubtfully towards the hills, then at the horizon beyond which was their ultimate destination. Perhaps this was the reason things had gone as easily so far, and perhaps—

This is me?

It'll be hobgoblins and UFOs next! Disgusted with herself for almost giving in to parapsychological mumbo jumbo, Jan was tempted to ask one of the women to give her face a good slap. Instead, she took a deep breath.

"OK, a side trip. But no more than a day. Agreed?"

"Agreed," Christine and Delsa echoed, as the three turned aside from the river and began to walk toward the hills.

They found the trail near the base of the hill where they had seen the light. The trail was of hard packed earth which had literally been worn into the trench between barbed thorn trees, which in turn became increasingly dense as the trail rose toward the crown of the hill.

"A game trail, I hope?" Delsa wished anxiously as she looked up and down the trail. Each woman clutched a small but lethal twenty-eight shot automatic.

"It is our only route if we don't want our hides ripped to shreds," Jan replied as she stepped onto the trail and turned up the hill. She gestured. "Delsa, behind me. Chris, behind Delsa. And Chris, don't be ashamed if you choose to walk backwards."

"I'll walk on my hands, if I have to," the agronomist muttered as she crab-footed behind her two com-

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panions.

Gradually, they climbed. It was warm, and the packs were heavy on their shoulders. But by unspoken agreement, the women kept themselves and their equipment together. The growth on either side of the trail grew thicker and higher, and the swordlike spikes of the thorn trees extended their cruel points low overhead.

"Who—er—whatever made this trail, is a bit more than our height, I'd say," Delsa panted as she looked up toward where the sunlight streamed barred shadows. Somewhere a catbird called, and was instantly answered by a chorus of meows and squeaks which seemed to come from every direction. The thorn forest rustled as if from a wind, although down at the level of the trail the air was stifling and still.

With frequent rests they continued for another hour, until the trail began to level and then widen. Finally, it became a broad, rough-paved pathway between two rows of low stone columns.

"What the—!" Jan stared with astonishment at this evidence of the work of intelligence.

"It's old," Delsa said, as she stopped and rubbed her hand over the worn paving.

"Positively ancient," Christine agreed.

"But still used," Delsa added.

"By whom?" Christine asked.

Jan only half listened to the exchange. She felt an overwhelming sense of relief combined with awe, as the prejudices of a lifetime shed from her psyche like a discarded skin. For the first time in her life, she fully comprehended the meaning of that wise line: *There are more things in Heaven and Earth—*

Followed by the others, she trod almost reverently along the pathway until it suddenly turned left and ended at the edge of a broad but shallow depression that cut into the hill just below its summit. The depression was about a hundred meters across, and was completely barren. A slightly tilted, twenty-meter cone rose from the center of this sterile area and was apparently half buried within it. The cone's polished metal blindingly reflected the sunlight.

"My gawd, it's a ship!" Delsa began to run forward, but was grabbed and dragged back as Jan spotted a hunched skeletal figure painstakingly descending a primitive vine-lashed ladder which had been erected against the side of the ship. As it descended each rung, the being carefully rubbed a large cloth on the metal on either side of the ladder, after which it lifted its head and uttered an eerie call. The piercing sound reminded its human listeners of a beast baying at the moon.

As soon as it reached the ground, the being dropped to its hands and scuttled like a four-limbed insect around the curve of the ship to a small stone structure which resembled an altar. It picked up something from behind the altar, uttered another of its eerie calls, and pointed the object. An opening appeared close to the ground, and another of the beings, also carrying a cloth, emerged from inside the ship and joined its companion. The object was again pointed, there was another baying call, and the opening closed.

Jan gestured, and led her companions away from the pathway to a new prone vantage point a few meters farther along

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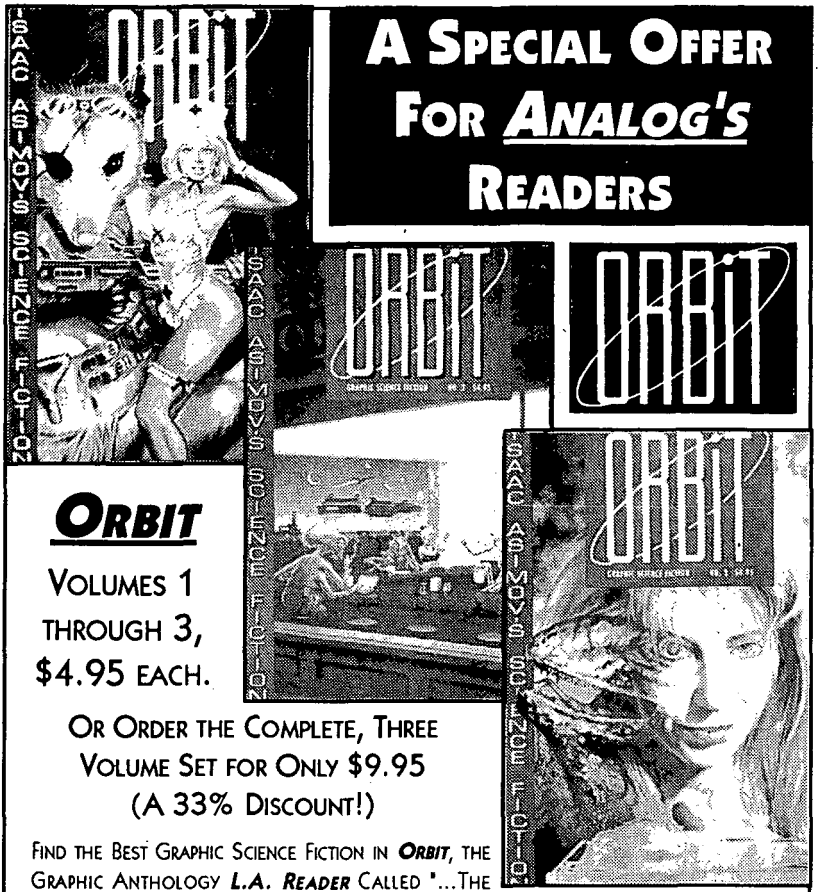

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the depression's rim. The wisdom of her precaution was quickly vindicated when four more of the beings appeared from along the pathway and descended into the depression. The new arrivals bore between them a long wrapped bundle which they laid on the ground between the ship and the altar. They reverently removed the wrappings, revealing the body of one of their kind. Then, as the four joined the two who were already behind the altar, there was a fluttering of wings and several catbirds spiraled down and landed on bony shoulders. One catbird stayed aloft for a few moments, circling with pitiful cries, until it descended and landed on the body. Finally the six beings, still with catbirds on their shoulders, filed out of the depression toward the paved pathway. As they went, they keened an atonal cacophony which only slowly faded as they returned down the trail. Christine later described the sound as a Gregorian chant run backwards.

"Well!" Jan said.

It was more epithet than exclamation, and reflected all their feelings. "Did you see any door open?" Delsa asked, still wide-eyed with astonishment. "I saw nothing move up, down, sideways or away. The opening simply appeared! What kind of technology can do that?"

Jan said slowly, "The same technology which brought down the *Child*, I think." She turned her attention from the ship to the lone catbird. It sat on the corpse like a small faithful guardian, still and determined.

Christine said hesitatingly, "So we have found the shuttle-killer, huh?" She bit her lip. "What do we do about it?"

Delsa was also looking at the catbird. "I want to go down there."

Jan stood up. Suddenly aware of their presence, the creature produced a low, rumbling call. It sounded ominous, if not exactly threatening. "OK," Jan agreed. "But slow and quiet."

"So what can a poor little catbird do?" Christine wondered with a confidence she did not entirely feel, as the three carefully edged their way into the depression. The ground beneath them was baked hard, like concrete. Their shuffling feet disturbed a deposit of fine dust which marked their progress with a thin, settling layer of haze.

They stopped a couple of meters from the corpse and tried to ignore the continuous, warning rumble of its guardian. Although the body was definitely that of a humanoid, any similarity to *Homo sapiens* was reflected only by the gargoyles on ancient cathedrals. The head was almost perfectly round with a wide gash of a lipless mouth, two tiny eyes and a single recessed nostril below a protruding lid of bone. If there were ears, they were concealed under ropy hair which covered most of the head except for the face. The scantily clad being was either incredibly thin or incredibly emaciated, with a mottled brown skin drawn drum-tight over a bone structure which had lumps and joints as if it had been slung together by an amateur with not much sense of structural logic.

Christine looked at the complication between the being's legs. "At least we know it's a male."

"Yes," Jan agreed. "And humanoid."

"I hate to admit this, but I am sort

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of disappointed." Christine took a step toward the corpse, and promptly stepped back again when the guardian hissed and its wings lifted threateningly. "I grew up hoping that humankind's first E.T. would be an intelligent spider—or something."

"He does have a big brain case," Delsa noted.

Christine shook her head. "Which does not necessarily mean anything. It could be all mush in there."

"Damn right it's mush. He's dead, or haven't you noticed?"

"Cut it out, you two," Jan said irritably. "In any case, if we are discussing the possibility of these creatures being intelligent, then frankly I have my doubts. What we just witnessed was not so much intelligence, as instinct evolved out of ritual. Something which has been repeated so many times over so many years, its original purpose has been forgotten."

"Including the polishing?"

"Cleaning ship is an old tradition."

"And half burying it? How do you explain that?"

Christine shrugged. "Perhaps the ship triggered a land subsidence as it landed."

"Or someone else did," Jan suggested thoughtfully.

"Someone—" Christine looked blank. "Who?"

"An enemy. One which existed thousands of years ago. The *Child* could have been shot down because the ship still thinks it is fighting a war."

They had moved away from the corpse until they stood under the overhanging tower of the old spaceship. The ladder, an obviously temporary affair constructed of wood lashed together with vines, remained against the ancient hull. The catbird still did not move, although it watched them warily.

Christine nodded toward the corpse. "So I suppose these—ah—custodians are the degenerate descendants of the original crew?"

"It seems logical to assume so."

"But if their behavior has been reduced to blind ritual—"

"It would take hundreds of generations. In human terms, thousands of years."

Delsa frowned. "Then who shot us down?"

"I told you, dear. The ship did."

"Come on, now. No machine can last that long!"

"You don't think so?" Still slightly astonished at her new role of devil's advocate, Jan continued, "Delsa, stand outside that hard Aussie skull of yours for a moment, and try to look at this situation with some degree of logic. Something beyond any technology you or I have ever heard of, completely screwed up the *Child*'s electronics. Now we have stumbled across an artifact which looks like it just came out of the factory, although it has probably been here since our own stone age."

"Two plus two equals four," Christine said. "Old polished miracle here spotted a potential enemy sailing overhead, and promptly did something about it." She added thoughtfully, "But considering what seems to be the relative level of our technology compared with—" She gestured at the bright hull. "Why did it bother?"

"Perhaps its masters were at war with everyone."

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Christine snapped her fingers. "With everyone? Then how come the previous Earth expeditions came in without any trouble?"

"They were lucky?" Delsa suggested brightly.

Jan smiled. "I doubt luck had much to do with it. More likely, we were the first victims of a self-healing technology. It is quite possible, you know, that this old ship has been fixing itself since it detected the arrival of the first expedition a few years ago, and found itself unable to respond." She turned toward the shining tower. "Now if we can only find some way to turn it off—"

She did not know why she had a sudden, obsessive desire to get away from there; why, even as she screamed, "RUN!" she was already frantically pounding up the slope. She felt the first wave of heat on her skin, heard an unearthly screech from the catbird, and was vaguely aware of someone else's echoing scream. As Jan forced herself through waves of pain toward safety, dragged by failing strength and vision, her skin burning, she could think of nothing except again to croak, "Run." With a last desperate spasm of effort, she forced her abused body to put on a final spurt that tumbled her over the rim of the depression and into a pain-numbed heap, which rolled her down the other side into oblivion—

"Jan," a voice said.

She opened her eyes, and with difficulty focused on Christine's blistered features. "Wha—?"

The other's lips creased into a painful smile. "Sorry. I forgot to bring the sunscreen."

Jan remembered. "Delsa?"

Christine turned her head away. "She didn't make it."

"Oh God."

Supporting each other, the two women stumbled to their feet. For a moment they clung together, then stood apart and examined their respective blistered faces. "You look awful," Christine said.

"Pot calling the kettle black," Jan retorted, forcing her own wan smile. She looked toward the slight rise of ground beyond which lay the depression. Despite her hurts, she felt physically functional. *Compared to being dead, I'm in excellent health.*

But not Delsa, Jan thought as she blinked back the tears. She wanted to rub her eyes, but suspected it would be wise not to antagonize raw nerve endings. "Are you sure she's—?" She could not say it.

"Perhaps you should see for yourself." Sensing the other's doubts, Christine added. "It's OK. I have already looked."

From the top of the depression, the scene was almost exactly as they had first seen it. The ship brilliantly contrasted against its own looming shadow. A second, much smaller shadow was cast from the stone altar. The rickety ladder was gone; burned away. So was the corpse of the alien and its small guardian—except where they had been, fine dust was already being dispersed by a vagrant breeze. Toward the top of the slope, almost a hairbreadth from safety, something charred and unrecognizable still steamed.

"Delsa—?" Jan swallowed.

Christine nodded. "I didn't see it

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happen. But I do know she was that side of us when we began to run."

Jan forced her reluctant analytical side into gear. The grief would have to come later. "So now we know why the area is sterile."

"I guess we do," Christine said. Her voice was toneless, devoid of expression.

Jan decided to prod the agronomist. It would be good therapy for both of them. "Tell me what happened."

"It is pretty obvious, isn't it? At regular intervals, perhaps once a day, the ship cleans up the neighborhood. I would not be surprised if that is the example the custodians are following when they go through their pathetic little ritual. Anyway, there are probably places in the galaxy where frequent site sterilization would be a good idea for any ship which hopes to lift again."

Jan tried, not too successfully, to imagine a forest of vines entwining a hull. Or huge tentacles reaching out from a surrounding jungle. "Could be," she said doubtfully.

"What other explanation is there? Everything organic has gone, including the ladder, the corpse of the alien—"

"—the catbird."

"—and our planetologist," Christine added tentatively.

"Yes." Again Jan looked at the remains of what had once been a human being, and found it difficult to connect with the memory of the irascible yet likable Aussie who had been Delsa Crawley. Tomorrow, presuming the next zap was scheduled for then, even that pathetic remnant of carbonized flesh would be fed to the wind.

She forced her thoughts to the catbird. "It saved our lives, you know. It warned us."

Christine frowned. "The catbird?"

"Damn right. I am convinced the species is empathic. Everything points to it."

"Oh."

Nevertheless, despite the other's apparent lack of interest, Jan persisted. "You said it yourself, Chris, when we made friends with those two young ones. Somehow they neutralized the conditioning which should have made us cautious as hell, and then played with our emotions like two friendly tabbycats. If anything good has come out of this, at least it is the knowledge that the catbirds apparently like us. In some respects, I guess we must be similar to the beings who originally brought them here."

"The custodians, you mean?"

Jan shook her head. "The custodians are remnants, mere shadows of what their ancestors used to be. If for generations the catbirds have been desperately looking for something which is no longer there, it is just possible they found it in three human strangers."

"Especially if there are more catbirds than custodians. It would explain a lot, wouldn't it?" Smiling absently, Christine stepped over the rim of the depression and walked down the slope toward the ship.

"Chris—" Even as she uttered the protest, Jan realized she had no intention of stopping the other. Instead, she shrugged and followed.

First they stopped at the spot where the alien corpse had once been. The heap of dust was now almost gone; what was left was barely discernible from the

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powder which already covered most of the depression. The agronomist stopped and picked up some of the dust. As it dribbled through her fingers, she mused, "Is this just custodian? Or is it a mixture of catbird and custodian?"

Jan shrugged. "Your guess is as good as mine. I was too busy getting the hell out of here to see whether or not the catbird remained." She hesitated a moment, then nodded. "But I think it's a mixture."

"The poor beast loved its master so much, it could not live without him. Is that it?" Christine brushed the dust off her fingers. "God, there must be a better explanation than that."

"Not necessarily. Dogs have been known to act that way."

"Would a dog warn off others, if it knew their lives were in danger?"

"It might bark, I suppose."

"It might bark," Christine mimicked. She laughed. It was merriment without humor. "Jan, do you know what I think? I think you are right. In its own peculiar way, that faithful little companion did bark!"

Not liking the note of strain in the other's voice, Jan decided to change the subject. She pointed. "Let's see what's behind that altar."

The back of the altar was hollow, with a single stone shelf. A copper-colored rod, about a hundred millimeters long, lay on the shelf. Jan carefully picked up the rod, hefted it and then examined it. It was feather-light and apparently featureless.

Christine peered over her shoulder. "The key to the door?"

Jan ran her fingers over the rod until she felt a slight hollow near the base. She pointed the rod at the ship and pressed her thumb into the hollow. Without noise, and without visible evidence of a door swinging or sliding, a circular opening promptly appeared in the hull. Jan pressed the hollow and the opening disappeared. She pressed again, and the opening reappeared.

Jan took a deep breath. "It's the key, all right." She handed the remote to Christine. "Hold onto it. If the door closes behind me, use this to open it again."

"You're going in?" Christine asked unnecessarily.

"Someone has to. If I am not out within five minutes, or if the opening closes and this 'open sesame' gadget doesn't work, get the hell out of here and continue on to Curtis."

Christine nodded. "Just don't touch any buttons," she said unsteadily.

The inside of the ancient ship was an exercise in vertigo. There were no horizontal surfaces, no clearly defined rooms or spaces, and not a single straight line in sight. There was not even a recognizable light source; only a maze of glistening surfaces self-glowing with riots of clashing color, which rendered the interior into something out of an interior decorator's nightmare. Spaces snaked between the surfaces with no apparent purpose, and what appeared to be handholds were irregularly located everywhere Jan looked.

She started by working her way down from the hull opening. But after she had descended about twenty meters below ground level, finding herself surrounded by the same mad convolutions and still with the lowest level not yet in sight,

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she changed her mind and climbed back up. Strangely, hand- and footholds always seemed to present themselves where they were needed, and when she regained the daylight-flooded opening, less than a couple of minutes had elapsed. And she was not even slightly breathless. She stuck her head outside. "I am OK," she shouted. She jerked her thumb upward. "Going to try topside."

"OK," Christine called back. "Is everything as squeaky clean inside as it is outside?"

Jan glanced back to where the nearest surface reflected the sun like a gaudy fun-house mirror. "No dust, anyway."

The other woman pointed at her watch. "You have three more minutes."

"Make it five."

Jan was soon glad she had asked for the extra time. She ascended barely ten meters or so, when the passage suddenly opened into a space which at least made sense. It was circular, approximately twenty meters across (*That's funny. Outside, the ship does not look that wide*), four meters or so in height, and lined with display panels. If one squinted so that the odd colors and screen shapes merged into the background, it could almost have been the familiar control room of the orbiting and now empty *Amazon One*. Most of the displays were active, flickering with shapes and color. Only those before a row of three spindly chairs were not. The space-drive controls? Jan wondered. She looked at an enigmatic series of what she assumed were touch panels which ringed the deck below the displays, and appreciated Christine's warning about buttons.

So how do I turn off that damn weapon?

She knew she couldn't. It would need an expert to make that decision—except Jan was not sure that Genser's World's total human population of a few dozen people could provide such an expert. *But wait until we tell Earth about this. They'll send a ship stuffed with experts!*

In the center of the space, a narrow cone surrounded with further hand- and footholds, rose toward a dim opening in the ceiling. Jan did a quick mental visualization. That should lead into the nose of the ship, which was perhaps the location of the projector which had downed the *Child*. She glanced at her watch. There was still time.

She scrambled up the side of the cone and stepped into the upper level. It was not well illuminated, with only faint sparks of light relieving the gloom of the place. Jan removed a finger-lamp from her equipment belt and thumbed it on. The darkness swallowed the powerful little beam as if it was not there, and only when she almost blinded herself as she turned the beam on her face, did Jan realize that what was wrong had nothing to do with her equipment. Her heart thudding, she waited for her eyes to adjust—

When she got back to the hull opening, it was closed.

Jan did not panic. First she felt around the sides of the portal, seeking some kind of switch that would open it. Then she leaned against the nearest surface, closed her eyes against the lurid distraction of her surroundings, and forced herself to think.

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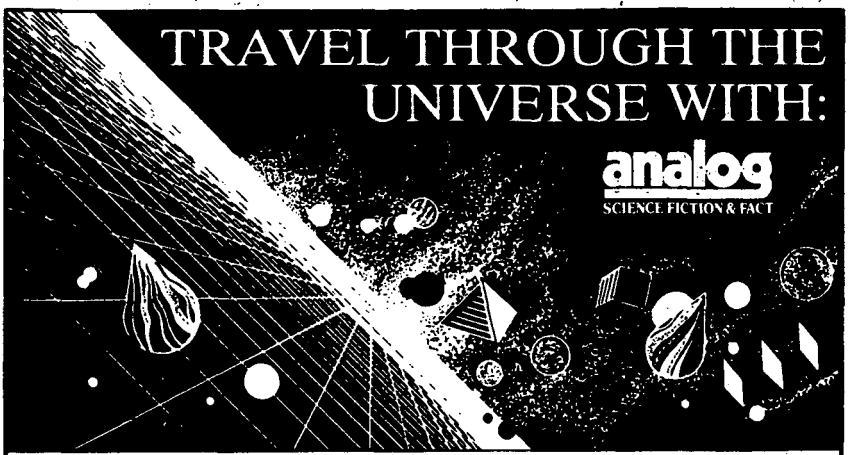

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Why?

It was possible, she supposed, the portal was on some kind of automatic timer which sealed the ship after a set interval. But if that was so, why didn't Christine use the remote to open it again? Or was there a ship's override which negated the remote? Was Chris, even at this moment, frantically thumbing the remote while she was wondering how long she dare stay?

Jan checked the time. Five minutes plus twenty seconds. If Christine stuck strictly to instructions, she should already be exiting the ship's sterile environs. It was, after all, still a long walk to Curtis, and now the agronomist remained the only hope for those back at the *Child*. Jan was certain, however, that the other woman was still outside, and would probably stay around for at least another hour.

Unless—

The custodians. How could she have forgotten the animated skeletons who fed their dead to the ship? Had they returned and taken Chris? It was then Jan felt the first stirring of panic. Oh God, am I stuck here? Does no one know—?

Jan grimly forced the panic back into her subconscious. But she felt its presence, ready to shatter her calm like a striking snake.

Tomorrow, she thought. *Tomorrow*. Yes, that's it! Presuming the cleansing is a daily ritual, the custodians will be back tomorrow. So she would not have to wait so long after all. Still, she could not exorcise the little demon of doubt. Even a few hours inside this psychedelic box could unnerve a stone, and despite her years of discipline and training, Jan Kraska cringed at the thought of thousands of slow seconds between her and the sunlight.

She gritted her teeth and stared with grim intensity at the blank inner face of the portal. It was a long shot, a very long shot. But direct mind-machine interface had, after all, been an experimental toy for decades. *Open.*

The portal remained blank.

Open, damn you!

Still nothing.

"Well, that's that," Jan said aloud. She laughed at the incongruity of those prosaic words; hardly appropriate considering her not inconsiderable lexicon of gutter-standard epithets.

She gasped as the portal suddenly opened, spilling brilliant light into the ship. She lifted an arm in front of her dazzled eyes, there was the sound of wings, and then something warm and pleasant thumped on to her shoulder. A soft little head rubbed against her cheek.

Meow?

A hand took hers and pulled her gently through the portal. Jan almost fell as she negotiated the half-meter which separated the bottom of the portal from the ground, but was supported by a firm arm. "Are you OK?" asked a familiar voice.

Carefully, Jan squinted into the brightness. Christine, with a second catbird on her shoulder, was watching anxiously.

Jan reached up and scratched a furry head. Her catbird warbled happily. "I'm fine, I guess. What happened?"

Christine gestured. "The door closed and wouldn't open for me. Then these fellows turned up and helped me out."

The "fellows" were four custodians

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who stood with motionless solemnity a little apart from the ship. Each had a catbird on his shoulder.

"What did they do?"

"I guess an adjustment is required from time to time." Christine looked at the custodians. "Anyway, one of them—don't ask which, because to me they are peas in a pod—took the remote, did something to it, and the door opened."

"Did he say anything?"

"Not a word. Frankly, I am beginning to suspect he and his buddies were brought here by the catbirds. Maybe these little beasts are the smart ones."

Again Jan rubbed the head of her catbird. Its presence was soothing. "Do you really think so?"

Christine shrugged. "Not really. But I do agree that the custodians are not very bright. You would expect, for instance, that when they saw a weird creature like me on their sacred ground, they would either tear me apart, worship me as an angel from their ship-god, or—" Christine's lips curled. "—at least show some kind of interest anyway."

"They did not, I take it. Show interest, I mean."

The two humans watched as a custodian pointed the remote at the ship, closed the portal, and then replaced the rod-like device on its shelf behind the altar. "Their reaction to me was about the same as their reaction when you came out of their beloved ship."

"Bare acknowledgement."

"You exaggerate, dear," Christine said sarcastically.

"OK, so they are unexcitable. They don't even seem to want to talk, unless it is to let loose a screech or two."

Christine shrugged. "The caterwauling is presumably reserved for ceremonial occasions such as ship-cleaning and funerals. Perhaps they do not have a prescribed chant for a mere glitch."

Jan's eyebrows rose. "Glitch?"

"That is what we are, you know. A glitch which had to be fixed. Otherwise, the ship apparently looks after itself."

Jan nodded. "Which is our main problem, and I am afraid it may be one without a solution."

"Problem? What problem?"

"Just this. I am convinced there is no way we can turn off anything aboard that ship, let alone whatever it was that brought down the *Child*. Chris, I have just seen a technology which apparently manipulates space like we manipulate matter. Remember the old story about the awestruck savage paddling his dugout canoe into New York harbor? Well, that is exactly how I felt."

"It sounds like you got an eyeful."

"I doubt I can describe it using mere words, other than to say it is a topologist's nightmare. There is a control room of sorts, below a level which is—" Jan took a deep breath. "Chris, what do you judge is the diameter of the ship?"

Christine looked at the shining hull. "Fifteen, twenty meters or so. Why?"

"Because above the control room, there is an empty space as wide and tall as a cathedral. Don't tell me I imagined it, because I saw that space and walked around in it. Hell, it's not enough just to say it is bigger than the ship in which it is contained. It is *much* bigger!"

The other woman did not argue. Instead, she looked at Jan with a strange expression. "What you have just told

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me is no more impossible than what I can see with my own eyes. It's your face—"

"Mm—my face?" Jan exclaimed with horror as she lifted both hands. She felt the smoothness of healthy skin on cheeks, forehead, and around her eyes. There was no peeling, no painful sensitivity to the touch. Needing a comparison, she stretched a tentative hand toward the other's blistered face and, as Christine flinched away, brought her hand back. "Oh God, I'm sorry—"

White teeth gleamed amid the sunburn. "I doubt it was the deity who fixed you, Jan. More likely, it was whoever installed big spaces in small outsides."

Wordlessly, they stared at each other. "Weird," Jan said. As if it was sensing her confused emotions, her catbird warbled uneasily and rubbed against her cheek. Jan turned her head and met the creature's solemn gaze. "Can I keep you?" she asked softly.

Of course. It was not words, or even a mental equivalent. Nevertheless, somehow, Jan Kraska knew she had been accepted.

The two women tried to open the ship again. But the remote resisted all their fingering and prodding. The custodians did not interfere until Christine began to walk up the slope with the device in her hand. Then they moved with astonishing speed and blocked her way to the rim. As she tried to walk between them, they simply drew together until she bumped into an unyielding wall of bone and flesh. The catbirds—hers and theirs—meowed uneasily. The long, knobbly arms of the custodians remained loosely at their sides while four pairs of small, deep-socketed eyes met hers incuriously.

Christine returned down the slope and replaced the remote in its place behind the altar. "It was just an experiment!" she explained defensively.

Jan's eyebrows rose. "Would you have taken it if they let you?"

"Of course not."

"Are you sure?"

"Absolutely. And it isn't the custodians I am afraid of." Christine glared down the slope. "It's that damned ship!"

Jan nodded. "I suspect you are telling me you would rather not repeat what I did—and had done to me."

"Your cure?" Christine smiled thinly. "Forgive me Jan, but I think I will stay out of that Pandora's box and let nature and then the medic at Curtis take care of my slightly singed corpus. Staying sore for a while seems infinitely preferable to the chance the ship might not like me."

Jan recognized that Christine was being deliberately simplistic, as well as wise. The brain which controlled the ship—silicon-based, biological, optical or whatever—was not only incredibly ancient, it was probable that it operated on alien precepts in which "like" or otherwise was meaningless. Jan thought of the light-swallowing void she had encountered, and shivered. Was that void in fact vastly bigger than the ship within which it was enclosed? Or, as she entered, had Jan Kraska been reduced to the size of a mouse; experiencing a rearrangement of the matter within her body which at the same time had restored her damaged epidermis?

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Or had it happened at all?

Again Jan lifted a hand and touched healthy skin. That was real. The small head which pressed against the back of her hand was real.

So what have the catbirds to do with all of this?

Aloud, Jan rephrased the question. "Chris, do you think the catbirds are intelligent?"

The four custodians left the site with as little fuss as they had arrived. They made no effort to prevent the two women from following, in fact they acted as if they did not care. As the party crested the rim of the depression and descended down the pathway, all the catbirds spread their wings and soared to safety above the barbs of the thorn forest. From within the forest, the catbirds could not be seen. But their chorus of meowing calls was a constant reminder that although they were out of sight, they did not intend to be out of mind.

Despite the oppressive heat, the descent down the hill was at first relatively easy even for the two tired humans. The custodians plodded on with silent stoicism, their knobby legs swinging with a curious, yet efficient gait, which caused them to slowly draw ahead until they were out of sight around a curve of the trail.

Exhausted, the women finally stopped at a small stream which trickled through a wood viaduct under the trail. A few meters farther on, the first clearing of the thinning forest was visible. It was like a sunlit room being viewed from a dark corridor. After they cautiously slaked their thirst from the stream and then filled their canteens, Christine lifted her head and shouted, "Are you there, little catbird?"

The answer was not quite what she expected. Something briefly eclipsed the light through the roof of barbs and foliage, there was an unearthly shriek, and then Christine was elbowed aside as Jan ran frantically toward the clearing. After an astonished hesitation, Christine followed, and reached the clearing just as the other woman fired several shots at what looked like a flapping gasbag with trailing tendrils wrapped around the still body of a catbird. "It killed my friend," Jan wailed as she fruitlessly pumped half a dozen more shots at the apparently impervious target. As the predator and its sad burden vanished over the forest; "And I have not even given him a name!"

There was a fluttering of wings. Christine's catbird descended to her shoulder and meowed sadly.

Your friend, too? Christine asked in the silent, empathic language which she was certain her small partner understood. Jan was clearly broken hearted, and for the next few minutes Christine found herself comforting the last person in the world she would have expected to break down this way. The steely, disciplined former first officer of *Amazon One* was showing a streak of sentimentality which was astonishing and totally uncharacteristic. Finally, Jan muttered through her tears, "I have never had a pet, you know."

Knowing something of the other's teenage background as a member of a slum gang in post-earthquake San Francisco, Christine was not surprised. She simply said, "I grew up on a farm. Most

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of the creatures I knew were destined for someone's dinner table." Her catbird squawked angrily and dug a claw into her shoulder with just enough pressure to make her wince.

"Why do I feel like this?" Jan asked, looking at the creature on Christine's shoulder with an expression which, if Christine did not know better, could almost be identified with jealousy. There was, at the same time, a dawning puzzlement on the aquiline features which spoke of an intense inner struggle. "Dammit, why do I feel like this?"

Jan was winning over herself. The anger was evident.

Christine felt unexpectedly defensive. "I think we should move on, don't you?"

"Hit me," Jan said.

"I beg your pardon?"

"Hit me, damn you. Give me pain!"

Christine swung her hand back.

"That's right. Hard!"

The catbird flapped into the air. The sound of the slap echoed across the clearing.

"Again!"

Christine slapped harder. Her cheek red, Jan staggered but stayed on her feet.

"Again!"

This time, Christine put all her force into the blow, and Jan went down. Groggily, she rose to her feet.

Christine flexed the fingers of her sore hand. "Not again," she pleaded.

Instead, Jan smiled ruefully as she rubbed her cheek. "Thank you. I think I can function now."

As their hands touched and then withdrew, Christine asked anxiously, "Are you sure? For a while, I thought—"

"Chris, I guess there is something in me that not even I suspected. When that aerial jellyfish took out my catbird, I felt a sense of loss which I suppose is like losing a child. Or a husband—?" Jan blinked and shook her head. "It is the sort of thing I hope does not happen too often in a lifetime." She watched as the other catbird returned to Christine's shoulder. "You have been adopted, I think."

Christine crooked a finger and stroked the furry head. "I think so, too."

"Do you mind some advice?"

"It depends on what it is."

"Don't get too attached to him." It did not occur to Jan to question why she was so sure this particular catbird was a male.

Christine bristled. "Why not?" she demanded. The catbird shifted restlessly.

"Because—" Jan shrugged. "Let's just say I do not want you to have to go through what I just did."

"Don't worry. Unlike you, I have lost animal friends before." Even as she said it, Christine was not quite sure why she put it that way. There had been a couple of rabbits, she remembered, and later a friendly beagle who shared most of her teen years. She had wept a little when her father called her at the Academy and told her of Tommy's death. But she had not found it necessary to tell her friends of her little tragedy, and after a few hours of private hiatus, life had proceeded much as usual.

She thought about Jan's agony over not having given her catbird a name, and wondered:

Why don't I want to give a name to mine?

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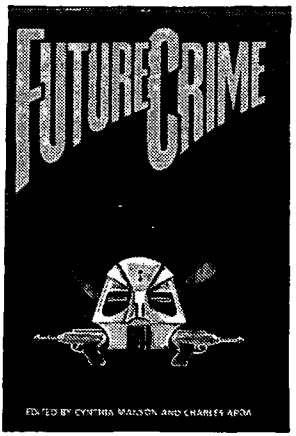

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They found the village a few hundred meters farther down the trail. Its buildings, which were stone-age primitive with mud walls and crudely thatched roofs, were surrounded by scrubby fields which indicated a desultory system of agriculture. Scattered among the buildings and even into the fields, were foundations of much older structures; some barely visible among the irregular rows of plants, others with tumbled walls and the gaping remains of doorways. Custodians wandered slowly between the buildings, or sat in the shade against the walls of their huts. Some, clad in sacklike garments which hung from neck to ground, were presumably females. If there were any young ones around, they were not visible.

Other than the disinterested turning of a few heads in their direction, the human strangers were barely acknowledged. Catbirds, some on body shoulders and others in the sky, reacted to the visitors with a series of warbling calls which were vigorously answered by the catbird on Christine's shoulder. "This one's taken," Christine translated with a proprietary smile. Nevertheless, a few catbirds came down to investigate. One even briefly landed on Jan's shoulder, uttered a squawk of disgust, and promptly took off again.

Remembering a small body clutched within ropy tendrils, Jan said wistfully, "I guess they know I am taken, too." But she no longer felt even a twinge of jealousy as she looked at the contented creature on Christine's shoulder. The punishment which she had forced her companion to administer, although crude, had proved an effective psychological cauterization. It was, she supposed, a victory of sorts.

They spent an hour wandering through the village. It was a frustrating experience to be so thoroughly ignored, as if the two humans were a normal part of the scenery. If it was not for the catbirds, who clearly shared an affectionate relationship with these otherwise uncommunicative beings, this could have been a community of zombies; the "living dead" of one of Earth's enduring legends.

"This is a dying town," Jan pointed out unnecessarily.

Christine nodded. "I have seen pictures of places like this. A couple of years of drought, local business closures, young people moving away—"

"Is that what you think?"

"Why not? If the ship is the center of their religion, then perhaps its priests are the only people who have a reason to stay here. It explains the lack of children, as well as their refusal to communicate with us. They are only allowed to talk to God, you see."

Jan remembered the caterwauling. "And when they do talk to their deity, my how they talk—" Despite herself, she smiled.

The theory that this was a specialized community devoted to holy matters, seemed to answer a lot of questions, although it did raise the obvious corollary that there had to be at least one other community of custodians located within reasonable distance. Jan wondered how the present inhabitants of Curtis, even Earth itself, would react to the news that mankind no longer had Genser's World to itself. It was in fact the first proof that the human race was

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not alone in the universe, and opened a door which mystics and philosophers had been seeking since Copernicus removed Earth to its proper and humble place in the grand scheme of things.

With the vital necessity of getting to Curtis on their minds, Jan and Christine knew they could not use up any more of their precious time in what would probably be a less than fruitful search for more custodians. So they left the village, following the lower slopes of the hills as they gradually turned north toward the distant coast. Christine's catbird, which she stubbornly refused to call anything except "Catbird," was pleasant company for both of them; even to the extent of occasionally riding Jan's shoulder—although the creature's relationship with the second human remained, as Jan sarcastically put it, "strictly platonic."

They had been on their way for less than a couple of hours, when Jan first noticed a billowing plume of vapor rising somewhere ahead of them. Catbird empathed discomfort when they did not turn aside, and finally voiced his objection with a series of angry squawks as they walked closer. Only when their nostrils began to detect the putrid smell of the gases being emitted from beneath the crust of the planet, did the reason for Catbird's reluctance become apparent. Finally, he fled from Christine's shoulder to a solitary, sad-looking tree which stood apart from the trail. He perched there and continued his objection with a blistering cacophony of noise which, had he been human, would have made most epithets tame in comparison.

"I don't think Catbird wants us to go any farther," Christine said uneasily.

Jan was unsympathetic. "Well, he has made it abundantly clear *he* is not going any farther."

"So he has a sensitive nose."

"So have I," Jan retorted. "But I am also curious."

Doing her best to ignore the increasingly foul odor, Jan headed toward a slight rise of ground from which she could hopefully view the phenomena. She was halfway there before she realized Christine was not with her. She glanced back. The other was still standing, clearly torn between opposing wishes. Jan snorted. *That thing's not just a pet. It's her goddamn owner!*

At the top of the rise, Jan stood for a long moment, staring with astonishment. She lifted her binoculars and stared some more. Then she gestured. "Chris, you have got to see this."

"See what?" the other called.

"Dammit woman, come up here!"

After a brief hesitation, Christine came reluctantly up the slope. She was holding a tissue to her nose. "Is this really neces—" she began. The muffled words faltered in her throat.

"Well?"

"Well what?" In a dramatic gesture whose effect was somewhat diluted by her screwed-up nostrils, Christine flung the tissue aside. "OK, so you have found more custodians!"

"Even more than that, I think." Jan handed over the binoculars.

Under moderate magnification, Christine looked down at a community which was more compact than the one they had explored earlier. The most notable feature of this particular village, which was in a shallow valley a few hundred meters downwind from the

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noxious plume, was the fact that it was completely surrounded by a thick, solidly built wall of mud and stone. She touched the zoom stud, and narrowed the field so she could study some of the distant figures who were moving between the buildings. Compensating circuits canceled the effect of her sudden hand tremor, as she realized they had found a missing piece of the puzzle. "The young ones," she breathed.

Perfectly proportioned; exact miniatures of the towering adults, the younger custodians ranged in height from a diminutive meter or so, up to what Christine supposed was the local equivalent of early teenage spurt. Only a few adults were visible, and they were gathered near the single gate in the wall. In contrast to their lethargic elders, the youngsters were constantly active, like particles in brownian motion. One of the adults lifted something to its mouth, and an unmusical blast signaled an end to the activity. The small figures merged into several lines and quickly vanished into the buildings. The slower adults followed.

"Class time?" the agronomist hazarded. "Or nap time?" She turned the binoculars toward the plume. She lowered the instrument, rubbed her eyes and looked again. "What do you know. This world is just full of surprises!"

Jan grabbed the binoculars. As the image snapped into focus, it was instantly obvious that the plume was not issuing from a natural ground fissure. Instead, the cloud of steam and gases was hissing out of the crumbled summit of a stone structure which could have been eons old, but which was more likely the plume-eroded remains of something more recent. There was a faint design on the lower part of the structure. The design vaguely resembled an aircraft with a bar across it. "What do you think it is?" Christine asked.

"How the hell do I know?" The taller woman took a deep breath, and instantly regretted it as she almost choked on the acrid fumes. "They drilled it," she gasped, "and then for some reason abandoned it."

"Why would they abandon such an accessible energy source?"

Jan longed for a lungful of cool, mountain air. "Maybe that was when their technology started to run out."

"Free heat and power," Christine murmured. "So close, and yet—" She shook her head. "What a damned shame."

"A shame," Jan agreed. Yet there was something wrong. Although she could not put a finger on it, she sensed there was more here than was immediately obvious. "Even if they could not figure out how to use it, you would think they would have capped it," she muttered, half to herself.

"Perhaps it was capped—once." Christine placed another, equally ineffectual tissue against her nose as she glanced back toward the small shape in the tree. Even at this distance, the sense of disapproval was strong. "Anyway, I agree with Catbird. It stinks around here."

Which was one obvious sour note. Jan grinned at the pun. Why was this village, school, or whatever here at all? The simple mud buildings hardly had the desirability or permanence to lock their owners into this fetid location, and

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surely they had long forgotten why their ancestors had tapped into this abundant supply of cheap energy.

Was it conceivable that to a custodian the stench was pleasant, even beneficial—especially for youngsters?

It was not a theory Jan was prepared to reject out of hand. Perhaps it even explained why the youngsters who lived here were active, and the adults were not. But that was a weak argument. After all, even human children are more active than human adults.

Jan was strongly tempted to go down into the village. But she knew her priority had to be otherwise, until those at the wreckage of *Amazon's Child* were removed to safety. Reluctantly, she turned away and headed down the slope.

Christine hurried after her. She was glad to be leaving this place, although she was mildly disappointed that Catbird did not instantly launch himself into the air to greet her. Instead, he waited until they passed under his perch, then dropped onto her shoulder with a single reproving squawk. Finally, as they turned toward the plain and the last vestige of odor faded behind them, he settled into a contented warbling.

Christine gently stroked the soft body. She suspected she was being manipulated to some degree, but did not mind. Why should she? Catbird was a friendly little cuss, and a lovable one. He was smart, he was clean, he was damn good company, and he apparently got that way on his own—unlike a dog, he did not have to be trained to heel.

Jan Kraska was also thinking, she hoped with some objectivity, about the third member of the party. There was, in fact, plenty of time to think as they plodded across the monotonous landscape. Since the arrival of Catbird, Christine had stopped being her former garrulous self. Not that she had become uncommunicative; it was simply that she no longer seemed to want to indulge in that pleasant little pastime called small talk. Although catbirds were nice to have around, it was apparently not an added pleasure. There had been a substitution.

Had that ancient ship also brought the catbirds to Genser's World?

Jan thought so. Whatever world the ship had come from, it was, she presumed, a world in which custodians and catbirds shared some kind of symbiotic relationship. Perhaps that relationship was the result of an eons-long evolutionary process, or perhaps catbirds had literally been bio-engineered to satisfy some psychological need of the custodians. If, for instance, there had not been dogs on Earth, it is entirely probable that humankind would have found a way to invent them. In any case, the custodian-catbird relationship had apparently become increasingly one-sided as the descendants of the original ship's crew gradually de-evolved both in intelligence and numbers. If the catbirds were genetically conditioned to the kind of relationship their ancestors had shared with the original crew, the arrival of the intelligent humanoids from Earth must have seemed like a sudden light in a long and gathering darkness.

A catbird in every house. Is that part of the future for mankind on Genser's World?

I hope not, Jan thought vehemently.

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Then, with an abrupt mental double-take: *But why not?*

The helicopter, an outsized "1" on its sides, found them two days later. Jan's flare was still streaming across the sky as it touched down.

In his joy and eagerness, its pilot stumbled twice as he ran toward them. "Amazons," he shouted happily, "Goddammit, you must be Amazons!"

He clutched them both, and the three did a clumsy dance among the grass tufts. Catbird, who had taken to the air with a startled squawk as the machine landed amid its own whirlwind, circled low. When the three breathless humans finally separated, he resumed his perch on Christine's shoulder.

"Well I'm damned," the man said as Catbird solemnly regarded him. "Well I'm damned."

Jan was amused. "Well damned, I am Jan Kraska, once first officer of the *Amazon One*. This is Christine Stadderfoss, our agronomist."

Christine stroked the small body on her shoulder. "And this is Catbird."

"Yeah? I am Garnett Podenski, former captain of the *High Hopes*." The man who had led the expedition to Lalande 21185 was stocky, with graying sandy hair and a broad smile. But his smile faded as he asked with concern, "What about the rest of you?"

"We lost one. Delsa Crawley. The others are OK, just waiting to be picked up."

"What happened? Your shuttle disappeared so fast, we were beginning to think it had blown up in flight."

"We crash landed."

"Is that when—ah—Crawley—"

Jan shook her head. "No. She died later."

After Jan had described to the best of her ability where the *Child* had come down, Podenski spoke rapidly into his wrist-mounted comset. He was wearing a phone, so the women did not hear—although they could imagine—the instant jubilation in Curtis. "Number Two will be on its way south within minutes," he reported after he broke contact. "Don't worry, ladies. Your friends are as good as found."

At first Catbird was reluctant to enter the helo's small cabin, but changed his mind when Christine climbed in. He perched on her lap, and allowed her to cup his body with both hands as the turbine whined up to speed and the machine rose into the sky. Despite the vibration, she felt him tremble as he pressed his small head against her. "Catbird's scared," she said.

Jan glanced back from her seat next to Podenski. "It has probably been a few hundred generations since his ancestors rode in anything like this."

Startled, Podenski looked at Jan, then back at his third passenger. "What do you mean by that?"

My big mouth! Jan had hoped to hold her explanations until they arrived at Curtis. "Do you know about catbirds?" she asked.

"I have only seen one. It strayed into Curtis about four years ago. Eric Gerenson called it Flyfel."

"Flyfel?" Christine frowned. "What kind of name is that?"

"It's not a name. It's a contraction of 'flying feline.' For some reason, Eric seemed reluctant to give the creature a proper name."

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Jan decided to change the subject. "Eric Gerenson? From the *Robert L. Cassion*?"

"That's the one."

"I am looking forward to meeting him. It is just possible he is a distant relative of mine."

"Is that right? Now that is very interesting. In fact, you might even do him some good."

"Good?" Jan echoed cautiously. "I am not sure I like the sound of that. Is there something wrong with Eric?"

"Let's just say he is—ah—not well."

"What is his problem?"

"Don't worry. It's nothing contagious." Again, the pilot turned his head and glanced at the two in the rear seat. He seemed worried. "At least, I do not think it is."

Jan was certain something had been left unsaid, but was reluctant to push the point. Podenski himself was obviously curious about what she had left out, especially concerning Delsa's death. So, fair being fair, there was not much she could do about it until they arrived in Curtis.

Nevertheless, it was a long forty-minute ride in which, between awkward silences and looking at the passing scenery, the conversation edged toward forced politeness. So it was a welcome relief when the plain abruptly gave way to a broad, tree-lined delta with a bright glimmer of ocean in the distance. Curtis was a neat cluster of buildings on a promontory which projected into the delta from the surrounding highland. As they descended, Jan glimpsed the wedge-shapes of two shuttles at the end of a landing strip. Each of the shuttles, she knew, was capable of returning to any of the three—and now four—empty starships in orbit over the planet. She wondered where the third shuttle was.

The welcome, as expected, was effusive. If they are enthusiastic enough, even a dozen people can make a lot of fuss, and the hugging and back-slapping left both of the new arrivals breathless. Catbird found a perch on the edge of one of the roofs and watched the proceedings with aloof interest.

The locals were of course mostly men, and despite her long-standing determination to take one thing at a time, Jan found herself surreptitiously studying the field. They were, at first impression, a reasonably good-looking crowd; ranging from short to tall, thin to stocky—on the whole a middle-of-the-road selection of eligible males which in time would hopefully sort itself out among *Amazon's* eligible females. The inevitable question; *Who will be mine?* trembled briefly on the edge of Jan's awareness, before it was put firmly aside.

Finally, the three local women separated Jan and Christine from the men and ushered them into one of the houses. Apparently satisfied that Christine was not going anywhere, Catbird allowed himself to be enticed on to Garnett Podenski's forearm, from where he permitted the curious inspection of the human males.

The inside of the house was spacious and comfortable, with well-crafted furniture suggesting a healthy permanence. "I am Evanne Stiegler," the first woman said. She was as tall as Jan, with lively blue eyes. She was also extremely pregnant.

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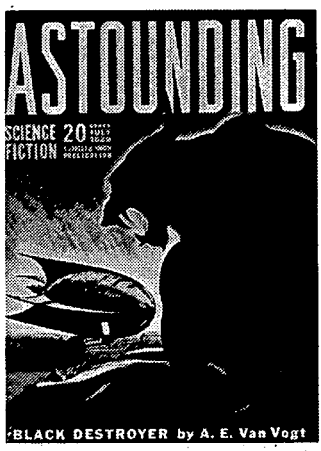

Critics mark this issue as the first "great" issue edited by John W. Campbell, Jr. It contains the first published story, "Black Destroyer," by A.E. van Vogt and the first story by Isaac Asimov to be published in **ASTOUNDING.**

This hardbound facsimile of the July 1939 issue also contains an Epilogue in which A.E. van Vogt, Asimov, and Rocklynne comment on their own work, their feelings towards **ASTOUNDING**, and especially their relationships with John W. Campbell, Jr.

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Jan smiled. "*Doctor* Evanne Stiegler, I think." She glanced at the distended belly. "It looks like you are about to become one of your own patients."

Christine said puzzledly, "But aren't you Howard Scheckart's—"

"—wife? Sure I am, and proud of it. And without blushing, I can tell you that Howard is proud to be my husband and the father of our child. On this world you see, the sexes are equal in every respect, including the right—even the obligation—to keep the names we were born with. And to answer the question which I can already see on your faces; it has been agreed that boys will carry their mother's name, girls their father's."

The second woman, a slender redhead, chuckled with wry amusement. "Don't let Evanne confuse you too much with the gory details of our tribal customs, which are subject to vote anyway. Under the skin we are the same people we ever were, and just as ornery. In other words, I guarantee you will be at home here." She held out her hand. "I am Joan Walsh, by the way."

"Oh yes," Jan said as she returned the handshake. "You are the psychologist."

"—who is married to Richard Burret," Christine said firmly, determined to get a few facts straight. "Right?"

Walsh smiled. "Right."

Christine turned to the third woman. "Please don't tell me. You are Melba Kan-Leger."

She was small and slight, with wide innocent eyes. "How could I be anyone else? With Richard and Howard fully claimed, stamped, and processed, and until now me being the remaining female among all the other lovely men—"

"Don't listen to her," the doctor said sternly. "Melba and Victor Kraskinn are the most thoroughly married pair you will meet anywhere."

Melba pouted. "Spoilsport!"

Already Jan and Christine were beginning to feel at home. Although these three women were obviously something special, or it was hardly likely they would have been selected to be part of mankind's first venture into extra-solar colonization, they shared and offered a camaraderie which would have been recognized by the pioneer women who helped open Earth's frontiers.

Jan said, "I only saw two shuttles as we came in. Where is the other?"

"Looking for you, dear," Joan Walsh replied. "Joe Hahvek and my husband took her up to your own ship, *Amazon One*, to see if you had left any clues as to what had happened." She glanced at her watch. "They should be de-orbiting about now."

"And Victor is currently on his way south in Helo Two," Melba announced seriously. "You and the other Amazons will be together again soon."

"There is one thing—" Joan Walsh looked through the window at the cluster of men around the creature on Podenski's arm. "Jan, are you free a moment? There is someone I want you to meet."

She led the way into the back of the house, to a bright bedroom where the sun streamed in through large windows that overlooked the delta and the sea beyond. There was a man in the bed; a wasted husk of an individual with blank

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eyes. An intravenous drip was connected to his arm. Another man sat at the side of the bed. "How is he?" Walsh asked.

"About the same." Then, bitterly, "Isn't he always?"

"Jan, this is Gellan DeZantos."

DeZantos's handshake was brief and disinterested. "Welcome to Genser's World."

Jan tried to ignore DeZantos's marked lack of enthusiasm. "And this is—?"

Walsh opened her mouth to reply, but was forestalled by DeZantos. "Meet Eric Gerenson, one of the members of the first expedition to this world; again my colleague when we returned in the *Robert L. Cassion*, and my own special friend."

Jan remembered now. She had read the dossiers on the previous crews, and understood DeZantos's use of the term "special friend." She smiled warmly. "It is possible I am related to Eric. A sort of distant cousin."

"Oh?" Suddenly, DeZantos seemed aware of her existence. He forced a wan smile. "In that case, perhaps you can help."

Joan Walsh explained, "We take turns looking after Eric, usually a week at a time. It's a chore of course, but Gellan is always a big help."

"What is the matter with him? And how long—?"

"He has been this way for six months, give or take a week or two. As far as diagnosis is concerned—" Walsh shook her head. "An extreme case of love-sickness, maybe. A sort of literal pining away for a lost one."

As they left the room, they heard DeZantos wonder plaintively, "Why couldn't it have been me?"

Later:

The stranded women had been located and brought to Curtis. The party which followed lasted far into the night. When it finally broke up, the lights in the various buildings started to wink out, Jan Kraska and Joan Walsh walked with Christine to a lookout which overlooked the delta. The larger of the two moons was just above the horizon, and cast a shimmering band of light over the calm waters of the estuary. Among the stars, one bright point moved silently eastward.

Walsh looked up. "That'll be yours. *Amazon One*."

Jan projected her imagination inside the drifting starship, to the tiny sleeping cubicle which still contained some of her personal belongings. Although she had been in stasis during most of the twenty-two year trip, her few months awake had created a small home amid the photographs and mementos of her past life. "It would be nice to visit the old *Amazon* once in a while," she said wistfully.

"You will have to apply for the next maintenance flight. Our fuel synthesis capability allows about one visit per ship per year—or did. Now, with four ships up there, not to mention the just-completed round trip to your ship, it looks as if the schedule will be out of whack for a while."

Christine stroked Catbird, who purred sleepily on her shoulder. "Which is very interesting, but I am tired. Why did you two insist on my company?"

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Jan and Walsh exchanged quick glances. "It has to do with Catbird," Jan said.

Christine smiled. "I am not surprised, considering the fuss he seems to have caused. So what is it? Pets not allowed?"

"You saw Eric Gerenson?"

"Just through the bedroom door. I was told he has been ill for a long time. What's wrong with him?"

Walsh said, "You heard about the flyf—catbird which Eric adopted about four years ago?"

Christine nodded. "I heard."

"The two became inseparable. Not that anyone had any reason to complain, not even DeZantos. Eric remained Gellan's affectionate friend, as well as one of the more productive members of the community. Then, about six months ago, Flyfel suddenly got sick and died."

Even in the dim moonlight, Christine's distress was evident. "Which was when Eric became—?"

Walsh nodded. "You understand, don't you?"

"Oh god." Christine turned away. Catbird meowed uncomfortably.

"From what Jan told me of your experience among those people you called the custodians, it is apparent the bonding is for life—literally. When Flyfel died, it was as if half of Eric died."

"It works both ways," Christine said dully, remembering the fierce loyalty of the creature waiting to be incinerated along with the remains of its beloved companion. "Jan?"

"Yes, Chris?"

"You were lucky, you know. When your catbird got killed, you were not completely—" Christine hesitated.

"Imprinted?" Walsh suggested.

Jan wondered aloud, "What is the normal life span of a catbird?"

"Obviously less than that of a custodian," Walsh replied grimly. "Otherwise, why the need for that other village you told me about—the one where their young are restrained within an area the catbirds will not go?"

It was like a revelation, instantly snapping into mental focus the design Jan had seen on the structure at the base of the gas plume. A crossed-out catbird! Shocked, Jan turned to offer comfort to Christine. But she need not have bothered. An empathetic message of comfort had already been offered and gratefully received.

Do not be sad, dear one. We will be together—always.

Christine was content.

Slowly, they walked back toward the now almost darkened community of Curtis. Genser's World was like Earth before the advent of industrial man, and Jan was grateful to be here on this lovely, unpolluted sphere. Undoubtedly, an early priority would be to organize an expedition to the half-buried ship of the custodians, hopefully to deactivate its weapon, and even—with a little patience and luck—to begin a process which would turn the degenerate descendants of its builders away from their long slide toward oblivion. And there would be another, more ominous reason to seek out the custodians.

She looked at the creature nestled into the hollow between Christine's neck and shoulder. The symbiosis was undoubtedly beneficial to both parties; a

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relationship of genuinely unselfish love which demanded nothing—as long as both remained alive.

The decision would have to be made soon.

The slaughter was fast, thorough and complete. When it was over, no free catbirds remained. And when the hosts eventually died, of course no catbirds would remain.

But Catbird and those of his kind who were already bonded, did not mind. Anymore than they did not mind that their partners never seemed to get around to giving them individual names. After all, why should they? They were loved— ■

IN TIMES TO COME

● Julia Ecklar, who won last year's John W. Campbell Award for Best New Writer for her previous appearances here, next month gets her first cover, for her first novella. "Blood Relations" is a gripping blend of adventure and scientific speculation, about a colony world whose ecology is a lot more interesting than the first colonists thought—or wanted. So they've called in a troubleshooter. The trouble is, an ecologist's view of an ecological problem may not be quite the same as that of the people who hired her....

Martyn J. Fogg's fact article deals with "Worlds in Darkness: Planets Between the Stars." That might at first sound like a contradiction in terms, but Fogg knows several ways that such things could come to be, and offers some intriguing speculations on what they might be like.

The rest of the fiction includes, among other things, new stories in a couple of popular series. Amy Bechtel's rural veterinarian, who has treated some strange things in the past, is back with "Stranger Things." And it's been too long since Charles Sheffield has shown us one of Captain Jeanie Roker's adventures with the McAndrew balanced drive, but "The Hidden Matter of McAndrew" is the strangest yet!

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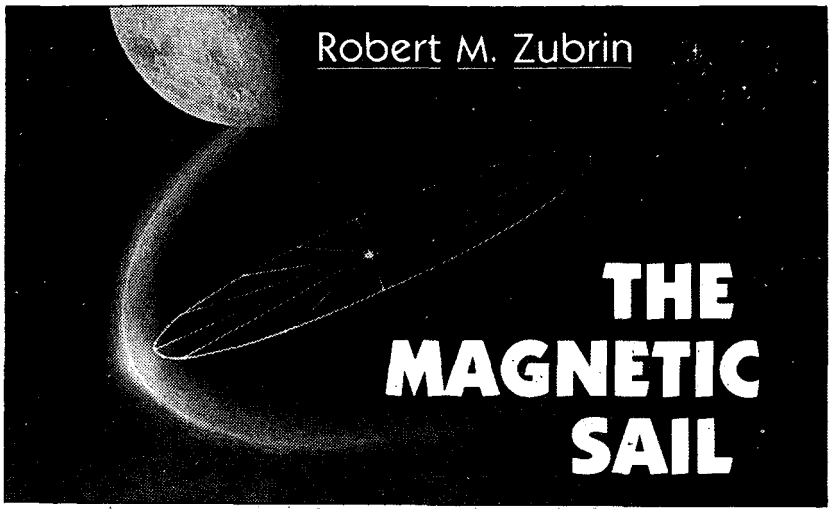

Two of the most fundamental axioms of exploration are that it is necessary to have mobility, and that true mobility can only be obtained if the resources required to support it can be obtained from the environment whose exploration is desired. This was the great stength of the sailing ships of the age of exploration, which derived their motive power from the very air through which they moved, and thus were free to travel at will across the vast distances of the world's oceans. Indeed, had Columbus been equipped with a coal-fired steamer, or even a ship driven by advanced diesel engines, instead of his simple caravels, it is clear that he could never have made his great discovery. With such systems it would have been unthinkable to cut loose from his European fueling stations for a speculative voyage into the great beyond. Again, during the 19th century, small teams of explorers traveling the Arctic by dog-sled and living off the herds of caribou were able to accomplish much more useful exploration, at much lower cost and risk, than fleets of steam-powered warships dependent on fuel and supplies they had hauled from home. To take a third example, Lewis and Clark would hardly have been able to cross the Appalachians, let alone a continent, had they decided to pack all the food, fodder, water, and air they and their animals needed for a transcontinental trip, rather than picking up what was necessary along the way.

These same axioms that have held true throughout human history for the exploration of the Earth also hold true for the exploration of space. To travel on, off, or around planetary bodies, we need to make use of the indigenous resources those bodies afford to provide rocket propellant whose transportation

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from Earth would drive mission mass and costs through the roof. To travel through space most efficiently, we need to make use of those resources found in space itself.

Interplanetary and interstellar space do not appear at first glance to be rich in resources, but they do have some. First of all, in interplanetary space, there is sunlight, which we already use to supply electric power to spacecraft by means of photovoltaic panels, and which can also be used to provide propulsion through the use of large ultrathin solar light sails. Planetary and stellar gravitational fields are also available, and these can and have been used to provide spacecraft propulsion through clever gravity assist maneuvers. In both interplanetary and interstellar space there is also matter, to the tune of about 5 million hydrogen atoms in plasma form per cubic meter in interplanetary space, and about 100,000 per cubic meter in the interstellar environment. The interplanetary plasma is streaming outward radially from the Sun at a velocity of about 500 km/s, a phenomenon which is termed the solar wind, while motion of the interstellar medium is unknown but generally presumed to be rotating with the rest of the galaxy and thus static with respect to the Sun and its near neighbors. Space also contains magnetic fields, of planetary, stellar, and galactic origin. To date, the plasma winds and magnetic fields of space have not been used effectively to drive spacecraft. In order to capitalize on these unused resources, in 1988 Dana Andrews (of the Boeing Aerospace Co.) and I (of Martin Marietta Astronautics), working in close collaboration, introduced a new kind of space propulsion device, which we call the magnetic sail[1,2,3,4,5,6] or magsail.

The magsail is a device that can be used to accelerate or decelerate a spacecraft by using a magnetic field to deflect the plasma naturally found in the solar wind and interstellar medium. It also can enable a spacecraft to push out of low orbit around a planet into interplanetary space by interacting with the planet's magnetic field. The magsail is not the first device that anyone has proposed to make use of space plasma for propulsion, and owes its origin in some degree to the conceptual prior art. The story of how it came to be is quite interesting.

Back in 1960, physicist Robert Bussard introduced one of the most beautiful concepts in speculative astronautics, the interstellar ramscoop[7]. In this concept a spacecraft moving through interstellar space used a ramscoop to gather the interstellar hydrogen as it flies, which it then reacted in a thermonuclear fusion reactor to produce thrust. The concept was terrific because it required no onboard supply of propellant, and the faster the ship went, the better the scoop worked, allowing the spacecraft to asymptotically approach the velocity of light. Unfortunately, the realization of the Bussard interstellar ramscoop faces two formidable obstacles. The first is that the interstellar medium is composed predominantly of ordinary light hydrogen, not the heavier and

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much more reactive isotopes deuterium and tritium that would burn easily in a fusion reaction. Ordinary hydrogen would probably burn much too slowly to produce useful thrust, although means have been suggested[8] that might allow us to catalyze its reaction with a carbon-nitrogen-oxygen thermonuclear fusion cycle that could increase the rate of reaction substantially. The second problem is the need for a scoop with a vast cross sectional area, so as to allow the effective gathering of the very diffused interstellar medium. With foreseeable materials, a scoop composed of physical matter would weigh so much that accelerating the spacecraft to useful interstellar velocities would be impossible. The remedy that has frequently been proposed to address this difficulty is to collect the interstellar matter not with a physical scoop, but with a magnetic field with a large radius of effective action.

In 1988, Dana Andrews was researching a concept of his that involved using a Bussard type magnetic scoop to provide propellant for an ordinary ion thruster which would be powered by an onboard nuclear reactor power source. This concept thus avoided the need for accomplishing the very difficult light hydrogen fusion reaction required by Bussard's original suggestion. Although potential performance was thus reduced far below levels that would be useful for interstellar flight, the system would be a knock-out for interplanetary travel as the freedom from dependence on ship-carried propellant would give the craft unlimited run of the Solar System. The problem was, as best as Dana could calculate it, that the magnetic scoop employed by the system was generating more drag against the interplanetary medium than the ion engines were producing thrust. The ship was going nowhere.

Since I have a pretty good background in plasma physics, Dana told me about his concept and the problem he was running into, and asked me if I could figure out a way to remedy the situation. At first I thought there might be a way, because Dana was using certain approximations to calculate the plasma drag that were very rough for the situation he was dealing with. Perhaps, I thought, if a computer program were written that could calculate the drag more accurately, the revised estimate for the drag might be low enough that the system could function. So we worked together writing such a program, only to discover, once it was operating, that the actual drag was much greater than Dana had originally estimated. At that point I suggested that we abandon the ion thrusters entirely, and rather than seek to minimize the drag, try to maximize it; to use the magnetic field not as a scoop, but as a sail, and derive the spacecraft's motive force from the dynamic pressure of the solar wind itself. Dana concurred, and we went back to the drawing board with a new approach. The magsail was born, and what a baby it was! For when the smoke cleared, we found that we had invented a system that could move pay-

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loads from low Earth orbit to any destination in the Solar System without using propellants and without regard to the usual launch windows that constrain conventional interplanetary ballistic flight. Furthermore, the same system could be used as a highly effective shield to protect space travelers from solar flares, or as a propellant-free brake for an interstellar spacecraft flying at relativistic velocities.

1. How A Magsail Works

The magsail's principle of operation is as follows: A loop of superconducting cable tens of kilometers in diameter is stored on a drum attached to a payload spacecraft. When the time comes for operation, the cable is played out and a current is initiated in the loop. Since the wire is superconducting, the current once initiated will be maintained indefinitely without further power. The magnetic field created by the current causes a pressure which imparts a hoop stress to the loop, aiding the deployment and eventually forcing it to a rigid circular shape. The loop operates at low fields strengths, typically 0.00001 Tesla (about 1/3 the Earth's magnetic field at its equator), so little structural strengthening is required. The loop can be positioned with its axis at any angle with respect to the plasma wind, with the two extreme cases examined for analytical purposes being the axial configuration, in which the dipole axis is parallel to the wind, and the normal configuration, in which the dipole axis is perpendicular to the wind. A magsail with payload is depicted in fig. 1.

In operation, charged particles entering the field are deflected according to the magnetic field they experience, thus imparting momentum to the loop. If a net plasma wind, such as the solar wind, exists relative to the spacecraft, the magsail loop will always create drag, and thus accelerate the spacecraft in the direction of the relative wind. The solar

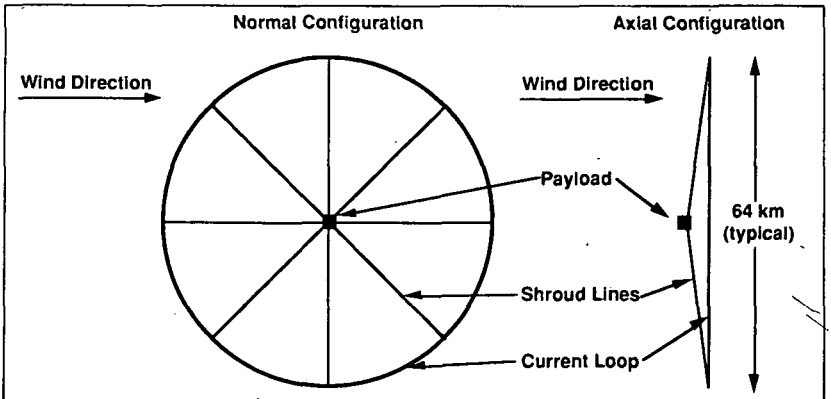

Figure 1: Magsail deployed with payload.

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wind in the vicinity of the Earth is a flux of several million protons and electrons per cubic meter at a velocity of 400 to 600 km/s. This can be used to accelerate a spacecraft radially away from the Sun and the maximum speed available would be that of the solar wind itself. While inadequate for interstellar missions, these velocities are certainly more than adequate for interplanetary missions.

However, if the magsail spacecraft has somehow been accelerated to a relevant interstellar velocity, for example by a fusion rocket or a laser-pushed lightsail, the magsail can be used to create drag against the static interstellar medium, and thus act as an effective braking device. The ability to slow spacecraft from relativistic to interplanetary velocities without the use of rocket propellant results in a dramatic lowering of both rocket mass ratio and total mission time.

If the magsail is utilized in a non-axial configuration, symmetry is destroyed and it becomes possible for the magsail to generate a force perpendicular to the wind, i.e., lift. Lift can be used to alter the magsail spacecraft's angular momentum about the Sun, thus greatly increasing the repertoire of possible maneuvers. In addition, lift can be used to provide steering ability to a decelerating relativistic interstellar spacecraft.

The magsail as currently conceived depends on operating the superconducting loop at high current densities at ambient temperatures. In interstellar space, ambient is 2.7K, where current low temperature superconductors NbTi and Nb_3Sn have critical currents of 1.0×10^{10} and 2.0×10^{10} amp/m^2 respectively. In interplanetary space, where ambient temperatures are above the critical temperatures of low temperature superconductors, these materials would require expensive and heavy refrigeration systems. However the new high temperature superconductors such as $YBa_2Cu_3O_7$ have demonstrated comparable critical currents in microscopic samples at temperatures of 77K or more, which would make them maintainable in interplanetary space using simple multi-layer insulation and highly reflective coatings. Assuming that this performance will someday be realizable in bulk cable, we have chosen to parametrize the problem by assuming the availability of a high temperature superconducting cable with a critical current of 10^{10} amp/m^2, i.e., equal to that of NbTi. Because the magnets are operating in an ambient environment below their critical temperature, no substrate material beyond that required for mechanical support is required. Assuming a fixed magnet density of 5,000 kg/m^3 (copper oxide), our magnet has a current to mass density (J/ρ_m) of 2.0×10^6 amp-m/kg.

It might be thought that a magsail could not operate effectively within the Earth's magnetosphere, because the solar wind is excluded from that region by the Earth's magnetic field. However, by interacting with the Earth's magnetic poles, the magsail can generate sufficient force to drive both itself and a substantial payload up to escape veloc-

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ity via a series of perigee kicks. Once escape has been reached, the magsail will find itself in interplanetary space where the solar wind is available to enable further propulsion.

The contrast between the mode of propulsion of a magsail operating within a magnetosphere as opposed to one within a plasma wind is depicted in fig. 2.

2. *The Magsail Operating in a Plasma Wind*

The operation of a magsail within the solar wind can be approximated by a dipole field (or a collection of dipoles) compressed within a boundary created by a perfectly conducting plasma. Within the boundary, there is magnetic field but no significant plasma pressure; outside the boundary there is a plasma stream with significant dynamic pressure ($q = \rho V^2/2$) but no magnetic field. The boundary is taken to be the surface in space at which the magnetic pressure $B^2/2\mu = q\cos^2\omega$, where ω is the angle between the free stream solar wind direction and the normal to the boundary surface[9].

The derivation and analysis of this fluid model was first presented in reference 2. It was found that, assuming a drag coefficient of unity for the area defined by the magsail's magnetospheric boundary, the self-acceleration of the magsail, D/M, is given by:

$$D/M = 0.6(\mu\rho^2V^4R_m/I)^{1/3}(J/\rho_m) \quad (1)$$

(Note: The definitions of all mathematical variables used in this article are listed in the appendix. Don't be intimidated by the equations. Feel free to skip over mathematical details to the sum-

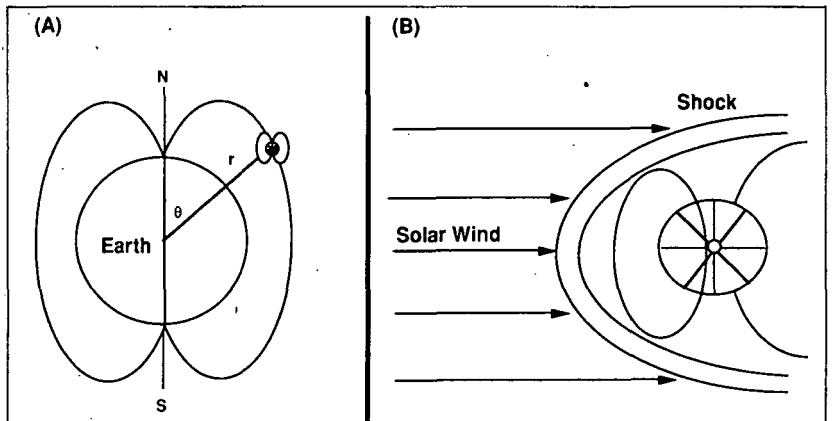

Figure 2: Magsail operating within a magnetosphere (A), and within the solar wind (B).

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maries of what they mean.)

If we substitute into this expression typical solar wind values of $V = 5 \times 10^5$m/s, $\rho = (8.35 \times 10^{-21}kg/m^3)/R_s^2$, where R_s is the distance of the magsail from the Sun in astronomical units, $J/\rho_m = 2 \times 10^6$ amp-m/kg, and $\mu = 4\pi \times 10^{-7}$ N/amp^2, equation (1) reduces to:

$$D/M = 0.02(R_m/(IR_s^4))^{1/3} m/s^2 \quad (2)$$

From expressions (1) or (2) it can be clearly seen that it is advantageous to construct a plasma wind interacting magsail with a small current (i.e., thin wire) but a large radius. Using equation (2) we find a sample magsail ($B_m = 10^{-6}$ T, $R_m = 31.6$km, I = 50 k-amp, wire diameter d = 2.52 mm) sailing at 1 AU has a mass of 5 metric tons and a self-acceleration of 0.0172 m/s^2. This performance would be degraded on an actual spacecraft in proportion to the weight factor W. The total magnetic energy contained in this sail is about 80 MJ, and the hoop stress is 11,760 psi. Thus this magsail can be "inflated" (i.e., have its current built up) by a 10 kW$_e$ solar panel power array in about 2.2 hours, and the magsail material can probably react the hoop stress without additional mechanical support. However, even if the ceramic superconductor had a tensile stength of zero, this hoop stress could be reacted by a reinforcement of high strength aluminum that would only add about 10% to the sail mass. Adopting this worst-case assumption, the reinforced magsail self-acceleration is found to be 0.015 m/s^2. A 10 kW$_e$ (at 1 AU) solar power source can be built for a mass as low as 300 kg, and so could easily travel with the magsail, allowing the magsail to be recharged if for any reason it is shut off during the mission. For missions to the outer Solar System a dynamic isotope power system (DIPS) would be more appropriate. Such systems, massing 800 kg and generating 6 kW$_e$, are currently under development by the US Department of Energy.

Lift can also be generated if the dipole is situated with its axis at some orientation intermediate between the axial and normal configurations. Using a hypersonic aerodynamics code, we have found simple dipole configurations with L/D as high as 0.14. If compound magsails were adopted, consisting of two or more loops connected by a spar along their axes, more desirable magnetospheric boundary shapes could be obtained yielding a much higher L/D.

3. The Magsail Operating Within the Magnetosphere

While the idea of using a magnetic field to sail on the solar wind is original with Dana Andrews and me, the concept of using the interaction between an onboard magnet and the Earth's magnetic poles to generate spacecraft propulsion is much older, and in fact was first proposed by J. Engleberger[10] in 1963. There was a significant error in Engleberger's derived equation, but the larger problem with his concept was that it could not be made practical due to the nature of then state of the art superconductors, and the concept appears to have received no further consideration after a 1971 Air Force review[11]. The invention

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of high temperature superconducting materials by Chu in 1987, however, has changed this picture dramatically. In 1989, Robert Forward suggested to me that the possibility of useful interaction between a high temperature superconducting magsail and the Earth's magnetic field should be investigated. In carrying out this investigation, I encountered the work of Engleberger, and derived a corrected version of his magnetic propulsion equations. The derivation was presented in reference 6 and results in the following equations:

$$\mathbf{F} = -3(B_e/r_0)IA(r_0/r)^4(R(\Theta)\mathbf{r} + T(\Theta)\Theta) \quad (3)$$

where:

$$R(\Theta) = (3\cos^2\Theta + 1)^{1/2} \quad (4)$$

$$T(\Theta) = (1/2)(\sin 2\Theta)/(3\cos^2\Theta + 1)^{1/2} \quad (5)$$

and "r" and "Θ" represent the radial and polar angle directions in spherical polar co-ordinates, with the poles placed at the Earth's magnetic poles (see fig. 2A). There is no azimuthal component to the force.

The values of the magnetic propulsion functions R(Θ) and T(Θ) are shown in fig. 3.

If we substitute in values of $B_e = 3.05 \times 10^{-5}$Tesla, $r_0 = 6.378 \times 10^6$m, equation (3) can be written:

$$\mathbf{F} = -1.46 \times 10^{-11} IA(r_0/r)^4(R(\Theta)\mathbf{r} + T(\Theta)\Theta) \quad (6)$$

Equations (3), (4), and (5) fully characterize the behavior of a self-stabilized magsail orbiting in an ideal dipolar geomagnetic field. There are several consequences that stand out immediately.

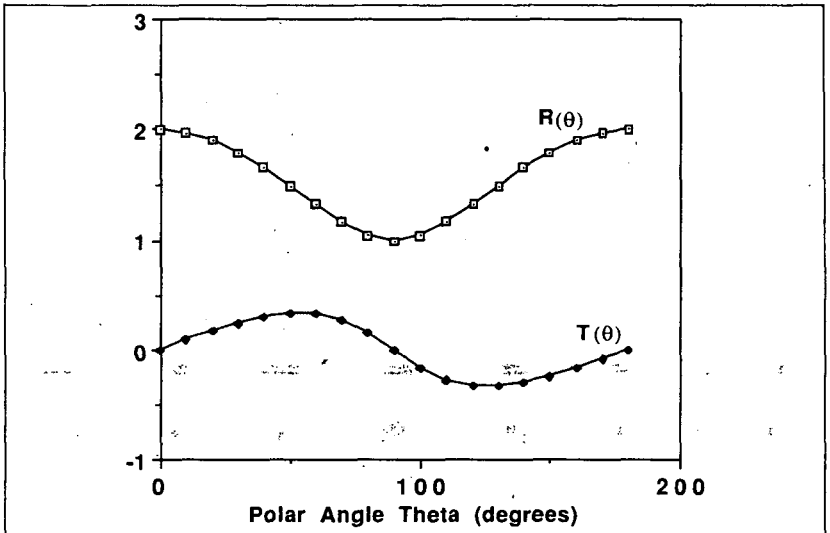

Figure 3: Magnetic Propulsion Functions R(θ) and T(θ).

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First of all, the dependence of F upon r^{-4} yields a rapid fall-off of thrust with altitude. This means that escape and orbit-raising maneuvers will be carried out by using a series of perigee kicks or thrust arcs in which the portion of the orbit during which thrust occurs is kept at a low altitude. Secondly, the dependence of F upon IA indicates that the maximum system thrust to weight will be obtained using a magsail of large radius and small B_m. This drives system optimization in the same direction as that indicated by the plasma fluid model for a magsail in the solar wind. Thirdly, there is no azimuthal force. Finally, the negative value of the constant in equation (3) combined with the values of $R(\Theta)$ and $T(\Theta)$ imply that the radial force is always inward, attracting the magsail to the center of the Earth, while the theta force always attracts the magsail towards the nearest pole. (If the magsail can be maintained in its unstable equilibrium position directly opposite the self-stabilized position, the sign of the force can be reversed.)

4. Utilization of the Magsail to Escape from LEO

Let us now analyze the case of our sample magsail being used to lift a 14 metric tonne payload from a low Earth polar orbit into a geosynchronous polar elliptical orbit with an apogee altitude of 71,090 km and a perigee altitude of 638 km. Such a satellite would be very useful for supporting communication in polar regions, as it would spend over 80% of its 24-hour-orbit traveling over the arctic. The magsail has a mass of 5 tonnes, and we assume 1 tonne for supplementary systems such as shrouds, solar panels, avionics, etc., so the total initial mass in LEO is 20 tonnes. This can be lifted into a polar LEO orbit by a Titan IV.

The magsail is switched on to generate thrust for an orbital arc between $\Theta = 80$ and $\Theta = 20$, with perigee kept at $\Theta = 50$ (south, magnetic) degrees. The spacecraft is orbiting in a true polar inclination, while the magnetic poles are traveling with the Earth's rotation and located at 76° N, 101°W (near Bathurst Island) and 65°S, 138°E (near the Adelie Coast of Antarctica), so we accept an estimated cosine loss term of 0.9 times the ideal thrust given by equation (3). The spacecraft starts with a 300 km perigee ($1.047\ r_0$), which in the course of the series of thrust arcs rises to 636 km, for a final perigee r value of $1.1r_0$. To be conservative we use the thrust level associated with a perigee of $1.08r_0$ for the entire transfer. For the thrust arc between 20 and 80 degrees, $T(\Theta)$ has an average value of 0.272. We thus find, using equations (3) and (5), that the average useful thrust of the magsail during the arc in question is 413 N.

The magsail thus has a self-acceleration of 0.0826 m/s^2, and the entire magsail system plus spacecraft system has an acceleration of 0.0206 m/s^2. This is a much higher level of thrust than would be available from an electric propulsion system of the same mass. An ion engine, for example, with an I_{sp} of 5000 s would require about 17 MWe to produce an equal thrust, and assuming a mass/power ratio ("alpha") of 5 kg/

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kWe (10 times better than the current state of the art) would weigh about 85 tonnes, or 17 times as much as our 5 tonne magsail. The relatively high thrust level available to the magsail in a geomagnetic field enables it to use a perigee kick strategy to achieve Earth escape.

A computer program was used to model our sample magsail mission. The results are given in Table 1. We see that 160 orbits are required with a total flight time of 34.3 days.

It is worth noting that if a cryogenic chemical stage with a specific impulse of 450 s and a dry stage mass fraction of 0.15 had been used to achieve this transfer, only 8.9 tonnes could have been delivered to the destination orbit off of our initial LEO launch capability of 20 tonnes. The magsail has thus increased the mass deliverable to the polar geosynchronous elliptical orbit by a factor of 14/8.9 = 1.573. While the use of low thrust ion electric propulsion could also achieve a similar improvement in mass deliverable, the required transfer time would exceed one year.

If an interplanetary mission is to be launched, two alternative strategies can be followed. One is to use the magsail as an Earth-orbital tug to lift the payload spacecraft to an elliptical orbit and then kick out onto an interplanetary transfer by staging off of it with a single kick of a high thrust chemical engine. Thus, in our example above, an interplanetary spacecraft staging off of the elliptical orbit to go onto direct trans-Mars injection would require a delta-V of about 1 km/s. With 14 tonnes starting out in the destination orbit, a cryogenic chemical stage (450 s I_{sp}, mf = 0.15) could then deliver 10,722 kg onto trans-Mars injection. This is compared to 6,430 kg deliverable by a cryogenic chemical stage firing directly out of LEO.

The more interesting method of

Table 1. Computer Simulation of Magsail Transfer from Low Polar Orbit to Polar Geosynchronous Elliptical Orbit

Orbit #	*Time*	*Perigee*	*Apogee*	*Velocity*
0	0 days	290 km	310 km	7.7 km/s
20	1.33	325	1,778	8.09
40	2.94	355	3,645	8.42
60	4.90	383	6,076	8.75
80	7.35	409	9,492	9.08
100	10.6	431	14,301	9.39
120	15.0	451	21,723	9.70
140	21.7	471	35,229	10.0
160	34.3	521	67,265	10.3

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launching into interplanetary space, however, is to simply continue the perigee kicks until most of the magsail orbit is outside the Earth's magnetosphere. Once such a condition has been achieved, the magsail can begin effective interaction with the solar wind to provide propulsion for the remainder of the escape maneuver and thence onward towards the interplanetary destination.

The Earth's magnetosphere extends outward to about 11 Earth radii, or 68,000 km, so we are just reaching the boundary in our example of transfer to a 1 day period elliptical orbit. If instead we were to continue the series of perigee kicks until a 4 day elliptical orbit with a 638 km perigee, the apogee of the orbit would be at 200,000 km with the large majority of the time of each orbit spent outside the magnetosphere. Using our computer model, we have found that the sample magsail described above, pulling a 14 tonne payload, will reach the 4 day orbit after 181 perigee kicks and a total transit flight time of 76.6 days. The magsail plus spacecraft can now be kicked out into interplanetary space by a trivial 178 m/s chemical perigee burn. Alternatively, if the orbit is aligned so that the outward arc of the ellipse is roughly parallel to the solar wind, the magsail can catch the wind and in the course of 1.1 days of sailing can accelerate itself to escape velocity. The magsail is now independently orbiting the Sun in Earth's heliocentric track.

The planets Jupiter, Saturn, Uranus, and Neptune are all gifted with substantial magnetic fields, enabling magsail manuevers in their vicinities utilizing the same technique as that employed in magsail manuevers within the Earth's magnetosphere. This capability could be quite valuable, enabling a mission in which a single spacecraft could make extended observations of each of the Moons of Jupiter, for example, before moving on to examine the next. As no propellant is required for magsail maneuvers, the survey could continue almost indefinitely.

Propulsive Significance of the "R" Force

Equations (3), (4), and (5) show that the magsail exerts a radial force with respect to the Earth, which for a self-stabilized magsail, has a magnitude about 6 times the Θ direction force and is always attractive. The magsail thus feels a self-acceleration (at perigee) towards the Earth of about 0.5 m/s^2, and the magsail plus payload combination we have analyzed feels a self-acceleration towards the Earth of about 0.12 m/s^2. This is equivalent to increasing the apparent gravity felt by the spacecraft during its perigee pass by a factor of 1.012. The spacecraft will thus require an initial perigee velocity of 7.77 km/s in order not to lose altitude while it travels through its initial perigee thrust arc, which means that the spacecraft should be launched into an initial orbit with a 300 km perigee and a 425 km apogee.

While the radial force generated by a self-stabilized magsail is always attractive, the magsail has an unstable equilibrium (no torque) position rotated 180 degrees opposite to its self-stabilized

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position where the radial force is repulsive. If a magsail can be maintained in such an orientation, and if the current density of the high temperature superconducting magsail cable can be increased by about a factor of 80 relative to that of existing low temperature superconductors (it will be recalled that throughout the present article we have assumed equal performance of low and high temperature superconductors), the *self-driven ground launch of the magsail* would become possible. For example, if our 5 tonne magsail can be made to carry 4000 k-amp (instead of the 50 k-amp assumed up to now), and it is launched from Bathurst Island near the north magnetic pole, it will exert a force at launch of 376,800 N. If it is carrying 1 tonne of spacecraft systems and a 3 tonne payload, it will self-accelerate upwards at a rate of 41.9 m/s^2, or about 4.27 g's. Since it is pulling directly away from Earth's gravity, its net upwards acceleration will therefore be 3.27 g's. The force is dying off as r^{-4}, so integrating the force from $r = r_o$ to r = infinity, it can be shown that the final velocity $v = (2a_o r_o/3)^{1/2}$, where a_o is the acceleration at ground level. In our present example this yields v = 11.68 km/s, which means that the magsail can launch itself and its 3 tonne payload off Bathurst Island onto a medium energy trans-Mars injection trajectory ($C3 = 24$ km^2/s^2), reaching the Red Planet in about 150 days.

5. Magsail Orbits in Heliocentric Space

Magsail orbits in heliocentric space can actually be calculated analytically, and methods of doing so were first presented in reference 2. In heliocentric space the force generated by the magsail's interaction with the solar wind is much, much greater than that created by the interaction between the magsail and the Sun's magnetic field, and so it is the plasma wind results presented in section 2 that are relevant here.

In order to calculate the orbit of a magsail spacecraft, we choose to parametrize the drag (thrust) generated by the magsail in the solar wind as a fraction of the Sun's gravitational attraction on the spacecraft. The Sun's gravitational acceleration $g_s = .006/R_s^2$ (in units of m/s^2), and the maximum magsail spacecraft acceleration $D/M = 0.015/(WR_s^{4/3})$ m/s^2, where W, the weight ratio, equals the mass of the magsail plus payload divided by the mass of the magsail. The apparent fraction, α, of the Sun's gravity operating on the spacecraft with its magsail operating at full current is then given by:

$$\alpha = (1 - D/(Mg_s)) = (1 - 2.5R_s^{2/3}/W) \quad (7)$$

If $\alpha = 1$, the magsail is not operating. If α is between 1 and 0, the spacecraft acts as a body moving about a star whose mass is the fraction of the Sun's mass represented by α. If $\alpha = 0$, the spacecraft feels no solar force and moves in a straight line; while if $\alpha < 0$, the spacecraft feels a net repulsion from the Sun and moves away in a hyperbolic orbit. In other words, because the magsail can exert a force against the Sun which can be comparable or even greater than the gravitational attraction that the Sun is exerting on the magsail

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spacecraft assembly, *the magsail can be conceived to be a kind of variable anti-gravity machine, used to adjust the Sun's effective gravitational mass seen by the spacecraft to fractional, zero, or negative values*. Once the effective mass of the Sun has been suitably adjusted, the magsail spacecraft orbit can be calculated using the well-established tools of standard orbital mechanics.

Lets say our 5-tonne magsail requires 1 tonne of additional mass for shrouds, solar panels, avionics, etc., and we wish to use it to transfer a 41.5 tonne payload (W = 9.5) from Earth to Mars. Assume that the magsail is co-orbiting with the Earth but outside of its gravitational well. Using canonical units [12] such that $R_{Earth} = V_{Earth} = GM_{Sun} = 1$, we can write:

$$E = V_{sc}^2/2 - \alpha/R = -\alpha/2a \qquad (8)$$

where E is the specific energy of the spacecraft, V_{sc} is its velocity about the Sun in canonical units, R is its distance from the Sun in AU; and a is the semi-major axis of its elliptical orbit. Since for a Hohmann transfer to Mars, 2a = 2.52, we can solve equation (8) for the required value of α (V_{sc} initially = 1) to send the spacecraft onto such an orbit. The result is $\alpha = 0.8289$. Checking equation (7), we find our spacecraft with W = 9.5 can attain an α at 1 AU as low as 0.7368, so it is capable of doing this maneuver. Since in this zero-lift trajectory angular momentum about the Sun is conserved, upon reaching Mars orbit, the ship will be moving with a velocity of V_{sc}(Mars arrival) = 1/1.52 = 0.6579. If we now wish to circularize the orbit, we use this value of V_{sc} together with 2a = 3.04 in equation (8) and find that the required value of α to circularize at Mars is 0.6579. Checking equation (7), we see that our spacecraft at 1.52 AU is capable of generating α as low as 0.652, and so it can circularize at Mars.

Our spacecraft is now moving in Mars's orbit about the Sun, but *at a different speed than Mars*. Mars is overtaking the spacecraft with a relative velocity of 4.564 km/s. This odd situation gives the magsail craft a very interesting capability. What it means is that the spacecraft can leave Earth for a Hohmann transfer to Mars's orbit, circularize, and then loiter at will in Mars's orbit until the Red Planet catches up to it. Thus a magsail interplanetary transfer can be done *at any time;* unlike ballistic interplanetary transfer orbits, there are no limited launch windows.

When Mars approaches the magsail can release its payload, consisting of cargo plus an aerobrake, allowing the payload to aerobrake into Mars orbit or land. Simultaneously, the magsail reduces its current partially so as to increase α back to 0.8289, sending it on a Hohmann transfer orbit back to Earth. Upon reaching Earth orbit, the magsail is turned off, and the spacecraft will circularize at 1 AU. If the timing of this maneuver is incorrect for Earth rendezvous, all the magsail has to do is make its initial Hohmann transfer back from Mars not to Earth, but to a circular orbit intermediate between Earth and Mars. The magsail can then waste as much time as required in that orbit to allow the Earth to attain the correct position

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for the final Hohmann transfer home. Since the intermediate orbit can be chosen at will, such return flights can be scheduled with great flexibility.

The time of flight of such magsail Hohmann transfers is given by:

$$\tau = \pi(a^3/\alpha)^{1/2} \qquad (9)$$

For our Earth-Mars Hohmann transfer, $a = 1.26$, $\alpha = 0.8289$, and thus $\tau = 4.88$ canonical units $= 283$ days—a time slightly longer than the usual Hohmann transfer ballistic flight time.

In Table 2, we show magsail requirements and capabilities for moving payloads to different planetary destinations in the outer Solar System, assuming no magsail lift. In Table 2., α_{trans} is the value of α required to initiate the transfer ellipse to the given destination, α_{circ} is the value of α required at that destination to circularize the orbit, $\alpha_{circ}0$ is the value that α would have to have been at 1 AU to allow the spacecraft to attain α_{circ} at the destination, W_{trans} is the weight ratio (the mass of the magsail plus payload divided by the mass of the magsail) allowable to permit the attainment of α_{trans}, and W_{circ} is the weight ratio allowable to permit the attainment of $\alpha_{circ}0$. The weight ratio actually attainable for any given destination is simply the lesser of W_{trans} and W_{circ}. We can see that a magsail without lift can move a payload amounting to 4 times the sail weight to any destination in the outer Solar System.

Finally, if we do not desire to go anywhere in particular, but only wish to rapidly accelerate out of the Solar System (as is required for the proposed Thousand Astronomical Unit probe, for example) we can set $W = 1.25$, and thus $\alpha = -1$ at 1 AU, becoming more negative was we move out.

Integrating the equations of motion, we find that the probe will be hurled out of the Solar System with a terminal velocity of 95 km/s, reaching 1000 AU in about 50 years.

If lift can be generated, the magsail becomes capable of changing its angular momentum about the Sun, giving it both greater maneuverability and payload hauling capability. The mathemat-

Table 2. Zero Lift Magsail Payload Capability

Destination	α_{trans}	α_{circ}	α_{circ0}	W_{trans}	W_{circ}
Mars	0.8289	0.657	0.741	14.60	9.66
Jupiter	0.5906	0.192	0.711	6.11	8.64
Saturn	0.5525	0.105	0.801	5.58	12.55
Uranus	0.5259	0.052	0.868	5.27	18.96
Neptune	0.5165	0.033	0.900	5.17	25.06
Pluto	0.5125	0.025	0.916	5.12	29.87
Escape	0.5000	0.000	1.000	5.00	infinite

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ics of the orbit transfer becomes more complex. Methods of calculating such orbits are given in reference 2.

The use of lift allows the magsail to adopt much more flexible flight plans between planets. For example, let us say we send the spacecraft on a zero-lift trajectory towards Mars. We arrive in Mars orbit, and dally until Mars shows up, at which point we release the payload and set forth on a transfer orbit towards Earth, all as described in the discussion of zero-lift maneuvers. Now, however, we apply negative lift to decrease the spacecraft's angular momentum about the Sun. In this case, when we arrive at Earth orbit, we need a value of $\alpha < 1$ to circularize, which means that we can now circularize in *Earth* orbit with a different orbital velocity than the Earth, and loiter until the Earth catches up to us. We thus have the ability to move large payloads back and forth between the Earth and Mars with the knowledge that rendezvous can be achieved at each end of the orbit without regard to when the spacecraft sets forth. This solves the problem that derailed the concept of cycling interplanetary "castles," i.e., the inability of these large manned habitats following ballistic interplanetary orbits to obtain a useful number of planetary encounters in their lifetime. In effect the magsail allows the castles to "cheat" against the laws of orbital mechanics by giving it the ability to adjust the effective mass of the Sun to that required to assure orbital rendezvous with the target planet at each end of the castle's commute. In addition, the use of negative lift allows the magsail to drop below Earth orbit to visit Mercury and Venus.

If lift is to be utilized, it becomes necessary to be able to control the orientation of the magsail. One way to accomplish this would be to connect the payload to the magsail loop with a set of tethers that can be either reeled in or out on a windlass. This would allow the magsail to shift its center of mass in either of the two dimensions within the plane of the loop. By moving the center of mass relative to the sail's center of pressure a torque can be induced, allowing the magsail to be swung into the desired attitude.

Above and beyond its propulsive capability, the magsail has an additional advantage as a system for manned interplanetary spacecraft, in that it shields the crew from the radiation dose they would otherwise receive from the solar wind and solar flares. Without such shielding, these hazards may well place a severe constraint on long distance manned spaceflight.

6. The Magsail as an Interstellar Brake

In addition to its role as an interplanetary propulsion system, the magsail also offers great potential as the braking device for an interstellar spacecraft that has been previously accelerated to relativistic velocities by some other means; for example by a fusion rocket or a laser pushed lightsail. In this case, the plasma wind is the apparent wind created by the relative velocity between the spacecraft and the interstellar medium. Using equation (4) with $V = V_{sc}$, $\rho = 1.67 \times 10^{-22}$ kg/m^3, R_m = 100 km, I = 159 k-

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amp, and W = 2 (a 50-ton magsail with a 50-ton payload), we obtain:

$$dV/dt = -1.66 \times 10^{-11} V^{4/3} \quad (10)$$

The solution of this equation is:

$$V = V_0/(1 + 3.68 \times 10^{-12} V_0^{1/3} t)^3 \quad (11)$$

where V_0 is the velocity of the spacecraft at the beginning of the braking maneuver. If V_0 is 3×10^7 m/s (one-tenth the speed of light) and braking time t is given in years, (11) becomes:

$$V = (3 \times 10^7 \text{m/s})/(1 + 0.054t)^3 \quad (12)$$

which will reduce V by a factor of 8 in 18.5 years. In 55.5 years V will be reduced by a factor of 64 to 468 km/s, a velocity suitable for magsail or fusion rocket braking within the destination star system. For all intents and purposes, the magnetic sail has eliminated the propellant required for terminal deceleration, with the result being a massive reduction in mission mass ratio.

The above calculation is based on an assumed interstellar hydrogen number density of $10^5/m^3$. This is quite conservative. Some astronomers put the estimate ten times higher, which would shorten the time scales given above by a factor of 4.64.

It should be noted that while research into the magsail has proven that a Bussard ramscoop composed of a simple current loop or solenoid would not work, it has not ruled out the possibility that more complex ramscoop configurations may be functional. Recently, for example, Brice Cassenti[13] has proposed using two very large magnetic toroids oriented with their axis along the line of flight of the spacecraft. The first toroid, with its weaker field, would act as a magnetic lens to focus electrons down towards the center line. The second toroid would have a much stronger field, in the opposite direction to the first, which would act as a lens to focus the protons. There are major engineering problems associated with the construction and operation of such a device, but it does offer some hope for the ramscoop. Cassenti proposes reacting the matter his scoop gathers with an onboard supply of antimatter to produce thrust. Since antimatter is, and in all probability will remain, very, very, expensive, it would be useful to reduce the amount of antimatter that would be required to accomplish the mission. If a magnetic sail were employed to decelerate such a craft, the amount of antimatter required for any flight would be cut in half.

7. Conclusion

We have seen that, provided high temperature superconducting cable becomes available with current densities equal to that of existing low temperature superconductors, magnetic sail devices can be developed with the potential to move very large payloads from low Earth orbit to high orbits, and then on to anywhere in the Solar System. Such magsails offer the advantage that they require no propellant, and can accomplish orbit transfer maneuvers without regard to the usual ballistic transfer launch windows. The required flight times are slightly greater than the usual Hohmann transfer ballistic flight times. Compared to a conventional solar lightsail, the magsail offers a thrust to weight ratio up to two orders of magni-

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tude greater, as well as a system that is far more robust and simpler to deploy.

But the greatest promise of the magsail is as an enabling technology for interstellar missions. By providing a braking device which requires no propellant, this simple device brings us half-way to the stars. ■

Appendix: Nomenclature

A = Cross sectional area enclosed by magsail loop (m^2)
a = Semi major axis of magsail orbit (AU)
α = Fraction of Sun's gravitational attraction felt by magsail spacecraft
B_e = Magnetic field on the Earth at the equator (Tesla)
B_m = Magnetic field at the magsail center (Tesla)
B_o = Ambient interplanetary magnetic field (Tesla)
D = Drag force exerted by plasma wind on magsail (N)
E = Canonical energy of magsail orbit
F = Force between magsail and Earth's magnetic field (N)
I = Magsail loop current (amp)
J = Magsail loop current density (amp/m^2)
L = Lift force exerted by plasma wind on magsail (N)
M = Mass of magsail (kg)
R_m = Radius of the magsail loop
r_o = radius of the Earth (km)
ρ = Density of the plasma wind (kg/m^3)
ρ_m = Magsail loop mass density (kg/m^3)
τ = Time of flight of magsail orbit ($years/2\pi$)
Θ = Polar angle in Earth magnetic spherical coordinates
ω = Angle between plasma free stream and the normal to the magnetospheric boundary
V = Velocity of the plasma wind (m/s)
V_{sc} = Velocity of magsail spacecraft (2π AU/year)
W = Magsail-spacecraft weight ratio (mass of magsail plus payload divided by mass of magsail alone)

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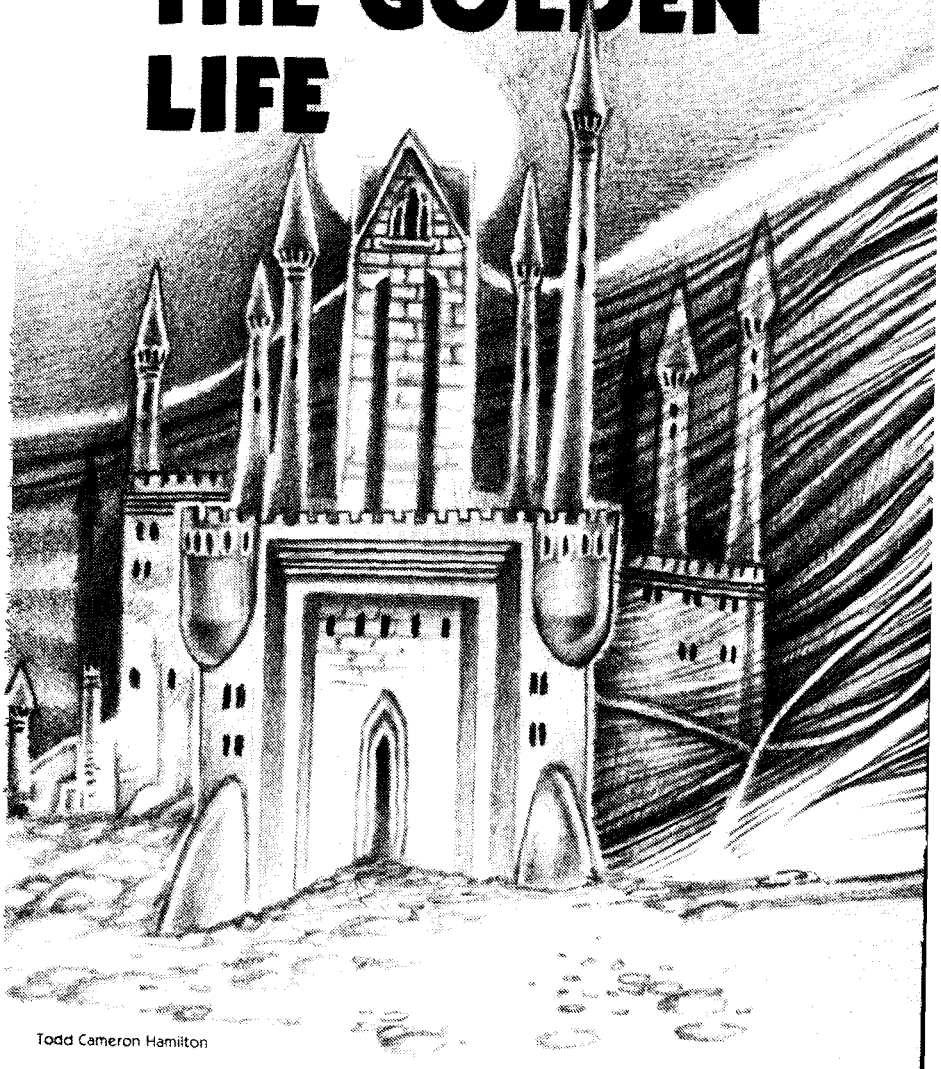
THE GOLDEN LIFE



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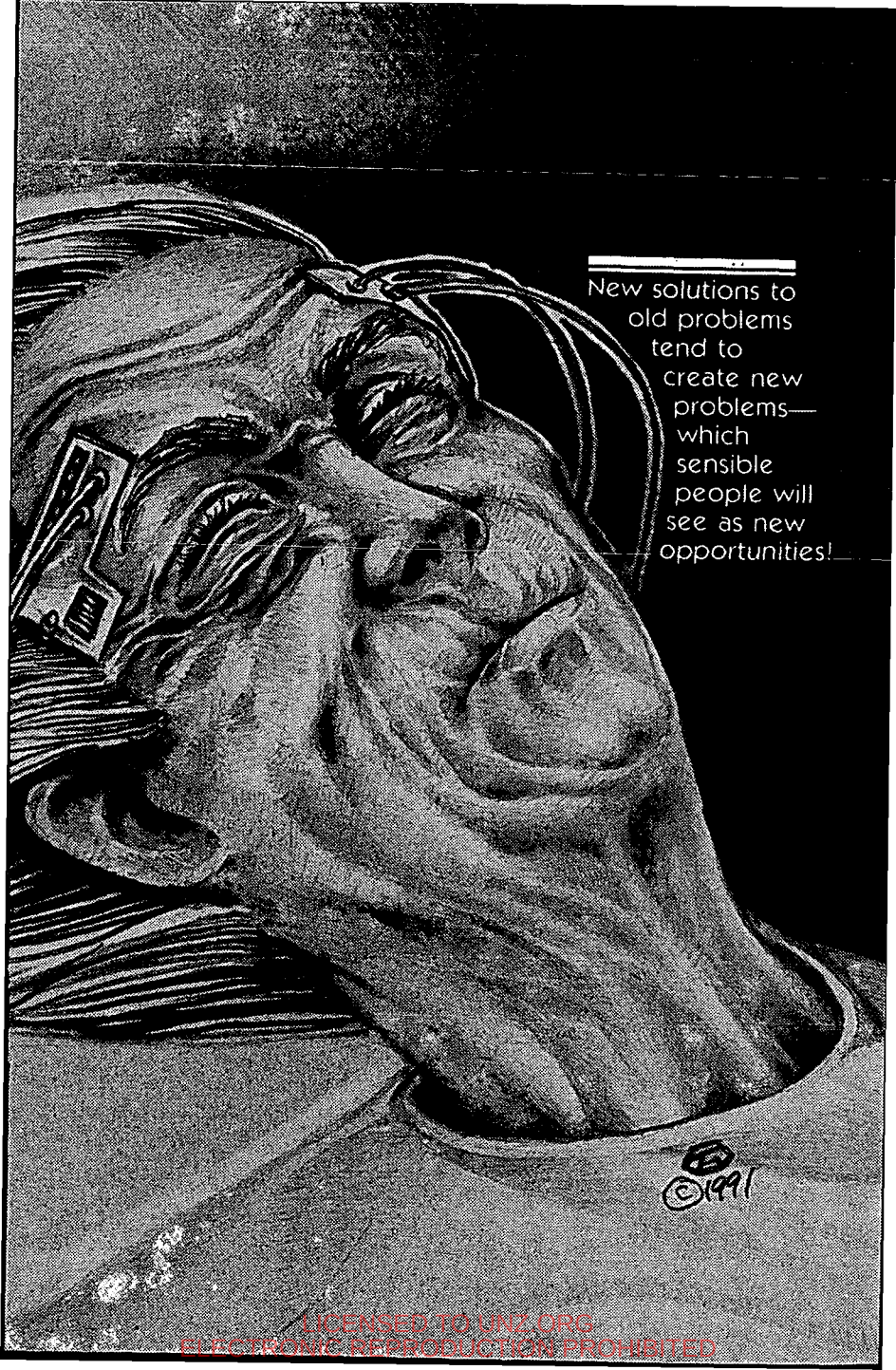

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"You don't love me anymore. If you did, you'd never even consider putting me in a place like this. Fine daughter *you* turned out to be."

"Mother, *please*. You know that's not true. What else am I supposed to do? I'm working twelve hours a day just to make ends meet. I can't give you the help you need."

"I don't need your help. I don't need anyone's help. There's nothing wrong with me except that I'm old. Is that a crime now?"

"Take care of yourself, can you? What about that fall last month? And your eating problem? And that other problem? I can't always be there when you need me. But this place—".

"To hell with this place. I remember when we put *my* mother in a nursing home, way back in '95. Thought *we* were doing the right thing, too. She died six months later. Is that what you want? You want me to die?"

"*Mother!* Listen to yourself. That was different. This isn't a nursing home. You know that. You'll be happy here. And I can come visit you as often as you like."

"Don't bother. Just lock me up and throw away the key. No more worrying about your poor old mother who's outlived her usefulness *and* her money. Well, what're you waiting for? Get out."

"Mom, I—"

"No, I insist. This is what you wanted. Well, OK. You win. You won't have me getting in your way any more. The old bitch is gone for good."

"I can't leave you like this, Mother. I wish—"

"You just save your breath. I've seen you for what you really are. Nothing you say will change that now."

"Mother, *please*. You're making this more dif—"

"Get out! Do you hear, you ungrateful little back-stabber? Get out! And I never want to see you again!"

In the hallway the tears started, and Kimberley found it nearly impossible to stop them. Things had never been quite the same with her mother since the stroke, when the burden of caring for her had fallen squarely on the shoulders of a young woman who had enough to worry about without doubling as nurse, maid, therapist, and housekeeper. Still, it was her *mother*. Hadn't she paid her dues? Wasn't it fitting that she now call in the debt?

"Damn," Kim whispered. She wiped at her face, but the effort was futile.

Someone behind her coughed. "Excuse me. Ms. Hobson?"

"Yes," she said, turning. "I'm Kimberley Hobson."

"Ah. You must be the daughter, then. Good. I'm Dr. Norman, and I'm the coordinating physician here at the Golden Life Alternative Facility. I know this is a difficult time for you, Kimberley—may I call you Kimberley? I just want you to know that your mother will receive the best of care. You've chosen wisely. I'd like to help you through this time of transition in any way I can. Please feel free to ask about anything you don't understand."

Kim smiled, thinking what a wet mess her face had to be. The man was nice, short but well-proportioned, with thinning hair and a ready smile.

"Thank you so much," she said. "I do have one or two questions,

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Dr. . . . Norman? Yes. Well, I mean, I've heard of your establishment, of course, and of others like it. I guess I'm like most people. I don't understand how such things can be possible. Once you've got my mother on total support, what happens then?"

He nodded as though he'd fielded this question many times before. "It's really quite simple," he said. "The patient's body is put on total support and carefully regulated by computer. At the same time, input jacks are implanted in her brain so that her selected alternate life can be played in directly without the need for cumbersome helmets and other apparatus."

"And she'll actually feel as if she's *living* that life? Not just watching it happen?"

"Absolutely. I want to stress how interactive the program is. Once she's selected the character—or alternate identity—she wishes to use, the program will be set up to give her literally thousands of choices at any given moment. Imagine a video game that plays twenty-four hours a day utilizing all five senses, and you get some small idea what it will be like for your mother. The detail is almost beyond belief. The experience is so close to reality that it virtually *is* reality."

Kim nodded. "I know I'm doing the right thing. It's just so hard to leave her, to admit that I can't take care of her any more."

"I sympathize. And I understand. Since the collapse of Medicare and Medicaid, care for the elderly has become our greatest problem. We like to think we've found the solution—for those who can afford it. The support system extends the body's life far beyond the norm, giving the patient several extra decades to live a life that is far happier, far more exciting and fulfilling than the real thing. We like to call it the Golden Life. Trust me. Your mother will thank you for it."

Kimberley smiled, and when Dr. Norman extended his hand, she took it, thanking him for all he had done. But as she walked away from the low, sleek building, she couldn't shake the feeling that this day, this very day, she had lost her mother forever.

The earth was very hard and dry, and the small group of men who had turned out to help bury the old man took turns hacking at the hole and sweating profusely in the midday sun. Each time Carlos's turn came, he would exert himself to the very limits of his endurance, stopping only when one of the others took the pick from his hands.

My father, he would think each time. *He wasn't really so old. And to die of TB in this day and age.* But Carlos saw more than the ragged group of friends with which he surrounded himself. He knew his father had succumbed, not to TB, but to poverty.

"Almost there, *amigo,*" said Juan as he passed the pick to the next man. "A few more inches, no?"

Roberto grunted, brought the pick down. Carlos watched the hole deepen as he felt his own bitterness grow deeper as well. It wasn't fair. No one on the east side could afford decent medical attention, and the free clinics required as much as a two month wait. This time, it had been too long.

The pick had completed another lap.

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Carlos hefted it, and as he worked he could feel the eyes of his friends upon him. He could sense their sympathy for him. He could sense many things. These people would never understand him, would never understand his difference. It was not only a matter of intelligence, he knew. It was a matter of caring, of acceptance. While they could endure this wretched life with only grumblings and mutterings for comfort, Carlos Calderon could not. Carlos Calderon saw too much. Carlos Calderon understood. His people were the victims of a system that held down the poor even as it raised the privileged to ever greater heights. Today's loss was but another example of this.

"*Bastante,*" one of them said. The hole was deep enough. Carlos nodded, ignoring the sweat that stung his eyes, and four of them lowered the body of Calderon senior into the earth.

"He came into the world with nothing," Carlos said, fumbling for words. "He leaves it the same way. His accomplishments? He lived. He lived until he died."

He fell silent to allow those who could pray the chance to do so. But Carlos did not pray. He no longer believed in a God that would inflict such suffering. This could not be. God would not be so unfair.

As they began to shovel dirt in over the body of his father, Carlos heard a low drone and saw a shadow move over the land. He looked up.

The blimp bore a large sign in letters so bright they shone even in the full light of day. GIVE THE GOLDEN LIFE TO SOMEONE YOU LOVE, read the sign.

Carlos gritted his teeth and kept shoveling.

"Thank you so much for coming, Kim. Before you say anything, let me apologize for the way I acted the other day. I was being a silly old woman. Can you forgive me? You know I love you very much."

Kim stood near the bed where her mother lay connected, via wires sprouting from her head, to a silvery panel set into the wall. She hesitated only a second before taking her mother's hand. "Let *me* apologize. I still feel bad about leaving you here."

"Nonsense! It's the best thing that's ever happened to me. If only you knew all the things that have happened. I chose a fairy princess as my character, and her name is Tamina. She's young and very beautiful and in love with a handsome knight. And she has powers, Kim. She can make people feel peace when before they only hated."

Kim listened as her mother went on, eyes burning with excitement, to tell of the adventures she had already experienced.

"It's so real," she said. "I mean, it's as real as you and I are now. Or it *seems* that real. And you know, I can't see where the difference matters."

"I'm happy you're happy. I felt so guilty, like I was betraying you. But maybe that Dr. Norman was right. Maybe this can be a whole new beginning for you."

Kim felt her mother's hand tighten around hers. "It's more than that, baby. It's what I've been waiting for my whole life. I'm doing exciting things now, things you could never imagine,

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and I'm with people who make me feel very special. I know it's all a dream, like a book that lives and breathes and makes you a part of it. But I cherish that dream. And I love you for having the courage to do this for me after all the trouble I've made of myself. I'll never forget it."

Kim found herself on the verge of tears. She'd expected anger and resentment during the visit, and she knew that this unexpected reaction should please her. Somehow, though, it troubled her.

"There's only one thing that bothers me, Kim. I know the cost of all this. One day you'll meet a nice man and want to start a family. It's not like it was when I brought you into the world. Now there's that childbirth license and all the taxes. Having a baby's too expensive for lots of folks. And there you'll be, spending all your money on me when—"

Kim rested a hand on her mother's shoulder. "You let me worry about that," she said. "When the time comes, I'm sure it'll all work out."

It took her broadest smile to cover the lie.

Carlos sipped the beer, thinking: *alcohol is one of the tools they use to keep us down*. But today, a week after the burial of his father, he welcomed the softening effect the beer brought him. His work had been exhaustive, as thorough as his resources would allow, and he knew his friends were beginning to think him mad.

"What's with all this stuff, *amigo?*" Juan asked.

Carlos looked around the room. Posters and advertisements covered the walls. Books were stacked on the table, the floor. Pamphlets and literature were everywhere.

"It's called research," he told Juan. "Something I doubt you'd understand."

"Oooh," Juan said, opening another beer. "Well, excuse me."

But Roberto, quiet Roberto, was more insightful. "It's been a week, Carlos. You have to let him go."

Carlos closed the book he'd been reading and placed it carefully on the table beside a map of the grounds of the Golden Life Alternative Facility. He looked into Roberto's dark eyes.

"It's not what you think, my friend. It's more. Don't you see how wrong this all is?" He waved his arms to indicate the posters and books. "How is it that so many people live on to ages of one hundred or more, while so many others are buried so soon in holes hacked out of the ground? I'll tell you: money."

Roberto sighed. How often had they heard him go on like this? How often had his words failed to pierce their complacency?

"That's the way of things," Juan said, shrugging.

Carlos felt the fire within him. "No! It cannot be! Money should not decide such things!"

Juan shrank back.

Roberto grinned tightly. "What can we do?"

"Something," Carlos snapped. "We are trapped. Can't you see that? They have us in life, locked in poverty with seldom a chance for escape. And now they have us in death as well."

He sensed it then. This was a pivotal

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moment. All his life he had tried to bring this message to his neighbors, tried to share with them the fire of discontent. He had lacked a focal point, and few had listened. But now he could feel the moment crystallizing around him. He could not be alone in his feelings.

"Brothers," he said, "it is time something was done."

". . . and not only do I get a raise as soon as the promotion becomes official, I also get reduced to a ten-hour workday."

"That's wonderful, honey."

Kim watched her mother closely. Ever since her arrival, she'd noticed a vague detachment about her, a slight confusion in her conversation. Or was it all imagination?

"I wish you could come back home with me, Mom."

"I know, Kim. I know. But I have important work to do here. There's a whole kingdom depending on me. And my family would miss me if I—"

"Mother," Kim said, worried, "*I'm* your family. Don't you remember?"

"Of course, honey. You know what I mean."

"You're scaring me, Mother. Have you forgotten that this world you're living in is just an illusion generated by a computer to—"

"Don't ever say that! It's real to me. That's what matters. That's the whole point of this place. Don't destroy that."

"You know I would never try to hurt you, Mother. It just seems like you're losing interest in real life."

"Nonsense. I admit, it's a little dull out here, a little grey. But I enjoy your visits. Really I do."

"I'm so glad. You know I miss you very much."

"Well, I miss you, too. Now, I know you've got to be running along, and so do I. There's a festival tonight, and I think Andalon's going to ask me to marry him. He's so handsome, Kim. Like your father, only better. He's the kind of man I've always dreamed of—the kind of man *every* woman dreams of. And he's all mine."

Kim smiled, patting her mother's hand. But the hand went limp while she held it, and the winking lights on the panel above the bed told her that her mother's dream life had resumed.

Kim left in silence.

Carlos kept a close eye on the operation.

"Hey, Miguel! Careful with that crate. You there—Sanchez? Let's get moving! We don't have all night!"

As the equipment was loaded onto the stolen truck, Carlos considered. The plan was unfolding quickly and flawlessly. He had managed to recruit a dozen trustworthy men from the neighborhood, and a friend of a friend in the army had convinced a guard to look the other way for a few hours.

After tonight, they would be armed.

Roberto sidled up to him. "What are we planning to do?" he asked. "Start a war?"

Carlos turned to the working men. "All right!" he shouted. "That's enough! Everybody on the truck! We're moving out!"

"Hi, Mom. How's everything today?"

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The woman on the bed stared at her in silence. Kim stared back. It wasn't her mother. Oh, the woman had her mother's face, her mother's build, her mother's hair. But there was something wrong with the eyes.

"Who are you?" the old woman demanded, startling Kim with her abruptness. "Speak!"

"What? I'm your daughter. Who do you think—"

"Silence! I demand an explanation. Where is this place? What witchery have you used to bring me here?"

"I don't understand—"

"I said be silent! I have great armies at my command. Refuse to aid me, and I shall order them forth to lay waste to all—"

She broke off when she caught sight of her own hands and followed them to the rest of her body. A sob escaped her before she clamped control over her features once again.

"You have gone too far, witch. You will transform me back to the way I was, or so help me, I'll—"

She stopped again, confusion in her eyes. Kim dared not move.

"My powers too? But only the Black Wraiths have the power to draw all magic out of a fairy. Do you serve them? Am I to be your prisoner in this strange place forever?"

Just when Kim felt she could take no more, the lights on the wall flickered through a complex series of configurations. Her mother lay still again, her eyes closed, her face blank.

There was a knock at the door.

Kim turned.

"Oh, Dr. Norman. I'm so glad you're here. Something's gone wrong. You've got to bring her out of it. I think—"

He raised a hand to silence her. "Now, now, Ms. Hobson. We're monitoring your mother quite closely. What you just witnessed was an episode of over-identification with her fictional life spilling over into reality. It's a fairly common side effect of the process—unfortunate, but nothing to worry about. Your mother is happy. That, I'm sure you'll agree, is the important thing."

"Of course," said Kim. "But I didn't count on *losing* my mother in the bargain."

"You haven't lost her. She lives—as Tamina. Who we are is really just a matter of who we perceive ourselves to be. Does this change make her any less your mother? Isn't it infinitely preferable to the alternative? Give her the freedom to enjoy her remaining years as Tamina. Give her that life."

Kim felt a stillness grip her, as if a voice that always spoke inside her head had suddenly fallen silent for the first time. "I want to see her again."

Dr. Norman was shaking his head. "I'm afraid that under these circumstances that would be extremely damaging to her newly evolved persona. The shock of—"

"You're saying you won't bring her out?"

"I'm saying I can't. Not without compromising her mental state."

Kim shuddered. Her initial perception, it seemed, had been correct. She'd lost her mother to this place. Perhaps the doctor was right; perhaps the alternative would have been worse. But that was intellectual justification only. It didn't fill the emptiness or still the panic

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that arose whenever she thought of her mother lost somewhere, trapped in another life and another place, unable to escape or even realize she was trapped.

"I have to see her," Kim said quietly. "I have to see her one last time—no matter the cost."

Dr. Norman sighed, but there was compassion in his eyes. "Very well," he said. "I can't deny you that. Please come with me. There is a way."

Carlos lowered the night goggles. "Unbelievable," he whispered. The place was almost devoid of security precautions. There were electronic monitors, but they would only help assure that his actions were witnessed by the outside world.

"I see only two security men," Roberto said, still peering through his own goggles.

Carlos nodded. He turned his head to take in the dozen dark shapes crouching in the shadows around him. It was a moonless night, but even so he could make out the angular shapes of weapons and assault gear. He turned back to the Golden Life Facility with its inviting lights and quiet sidewalks.

Could it be so easy?

Someone whistled. Carlos left his hiding place, moved stealthily to the cluster of bushes where Juan crouched.

"What is it?" Carlos whispered.

Juan indicated a metal box with two cables snaking out of it. He already had cutters in hand. "Power supply, I think. You want me to cut it?"

Carlos grabbed the cutters and flung them into the grass. "Don't be an idiot!" he hissed. "Cut that and you kill them all."

"But I thought—"

"No, you *didn't* think. This isn't about killing. We'll use minimum force. No one dies unless I order it. You understand?"

Juan nodded. "But how . . ."

Carlos passed him a tear gas mask. "Get ready. We're going in."

The sensation was not unpleasant. As the electrodes were inserted, Kim felt only the lightest of touches, like a feather tickling the inside of her skull. And when the program was activated, even that sensation vanished, though she was still vaguely aware of her body resting on the bed beneath the panel of flickering lights.

Darkness surrounded her. She looked down. Her body was a fair representation of the real thing, and she marveled at this as she raised a hand and flexed her fingers. The only oddity was her clothing, which was unlike any she had ever seen.

Somewhere in the distance, music was playing.

She looked around. The darkness was changing. Orange lights flashed by her, trailing ribbons of grey, and the darkness itself was growing structure as she watched.

It coalesced.

Kim gasped in surprise. She stood with several dozen people around a raging bonfire that illuminated a clearing in the dense forest. Smoke curled upward, grey against the black sky, and music helped to keep the night at bay. People were dancing, eating and drinking, jabbering excitedly about things which made little sense to her.

". . . he says, so I turned his sword

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into an eel for his troubles and flew away as a starling. You should have seen the look on the old scoundrel's face."

"We'll have a merry night of it, for come the morrow, we do battle with a clever foe."

". . . lovely tonight, doesn't she? And that Andalon. What a charming couple they make."

These last words were spoken by an old woman who gestured toward two young people dancing near the far edge of the clearing. Kim moved that way, drawn by something in the young woman's eyes, and before she knew it, she stood beside the couple.

The young fairy turned.

"Tamina," Kim said. "It's you, isn't it?"

The innocence and happiness in the young face hid a deeper knowing, a presence Kim knew well. And she knew the answer to her question before the woman spoke.

"Yes, I am that one, as most folk hereabouts know. May I ask who you are that you have to ask it?"

Kim smiled, feeling the texture of the sand beneath her feet, the gentle wind in her hair, the warmth of the fire and the sense of cold darkness beyond the flickering oasis of light.

"Don't you know me?" she asked.

Tamina hesitated. A brief frown crossed her brow, like a shadow cast by a cloud blown across the face of the moon. "You do seem familiar to me somehow," the princess said, "but I am certain we have never met."

Kim blinked back a tear. She sensed the edge she had reached, the cost of crossing that edge. There was so much she wanted to say, so much she wanted to ask. If only she could have said, "Are you happy here, Mother? Is this really what you want?" Then, perhaps, she could have known peace.

But Tamina's smile was joyful and childlike. Perhaps the question was answered without the need of asking.

"I must have been mistaken," Kim said. "Forgive me." And she turned to make her way back through the revelry and leave the two young lovers to themselves.

Later, when the fire had dwindled to embers and the festivities to sleep, Kim moved quietly to the clearing's edge where Tamina and Andalon had made their bed amongst the tall grasses. The night had grown cold, and she wrapped her cloak more tightly around her as she tiptoed toward the sleeping couple.

Kim smiled. Andalon did remind her of her father. He was strong and handsome with an open face and an appealing simplicity. Tamina lay entwined in his thick arms, and on her face was an expression of peace that reminded Kim of a better time, a time before troubles, when life glowed and it seemed there could be no wrong.

"I love you, Mom," she whispered. She bent to lightly kiss the fairy princess' forehead before drawing back with a sigh.

It was then that she became aware of her body on a bed somewhere far away while someone worked above her and something tickled the inside of her skull. Kim watched the sleeping Tamina even as the scene began to slowly fade, losing color and texture, into a growing swirl of greyness.

"Goodbye," she said.

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The greyness wiped out all trace of Tamina's world. Kim sat up. Dr. Norman was nowhere to be seen, but there was a man standing in the doorway.

The man had a gun.

The woman was just emerging from virtual reality when Carlos entered the room. Her expression of terror left a bitter taste in his mouth. No one had died in the assault, but there had been injuries.

"Don't be afraid," he said, trying to sound reassuring. "I promise you'll come to no harm."

She was frozen, staring at him. He found he could not hold her gaze for long, and he felt relief when Roberto came through the doorway to stand beside him.

"The building is secure," Roberto reported.

Carlos nodded. "Very good. Have the radio equipment brought in. I'll broadcast from here."

Roberto scurried away, and while his orders were being carried out, Carlos watched the woman's eyes go from glazed to fearful to angry as she drew herself up on the table but remained otherwise motionless.

Soon enough, it was time for the broadcast.

"My name is Carlos Calderon," he said into the mike. "I have seized the Golden Life Facility and have absolute control over the lives of the patients here. If I cut the power to their life-support systems, they die." He sighed deeply, wishing the woman's eyes would spare him, if only for a moment. He forced himself to remember his father and a crude hole hacked out of the hard earth.

"These are my demands," he said.

When the initial shock wore off, Kim began to sense the intense feelings that radiated from this man. There was a hard shine to his eyes, but they were intelligent eyes that revealed the pain within him. And as the others hurried to obey his orders, she grew to appreciate the respect he commanded. The man was driven, inspired by a cause he felt was just.

Kim shuddered. *Was* it just? Hearing his demands, she could almost sympathize with him until she remembered her mother's fragile condition. Surely her body had not yet become dependent on the support system, but would her sanity survive the abrupt emergence into reality? If the power were cut . . . No, she would not think about it.

Several times during the hours that followed, Kim and Carlos were left alone in the room while the others were occupied with various tasks. In these moments, Carlos would explain his position to her. It almost seemed as if he were trying to justify himself to her.

"It's not right," he said at one point. "You people can afford to do these things. We cannot. Should money decide who lives and who dies?"

She trembled at the zeal with which he spoke. "I don't know," she said hesitantly. "Maybe not. But what would you do? Put everyone into virtual lives as soon as they reached old age? Who would pay for it all?"

He dismissed her argument with an impatient chopping gesture. "Always back to money. Let the government pay."

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"Suppose they could afford it, which they can't. Imagine millions of people on total support, living fantasy lives while they contribute nothing to society."

Carlos nodded. "But your mother—it's all right for her."

Kim felt her face darken.

"Forgive me," he said. "Don't think me unsympathetic. But you have to understand not all of us have it so easy."

"Easy? I've sacrificed a lot to do this for my mother. I'd like to get married and have a family one day. Do you know how much the childbirth license is now?"

His expression changed. "I didn't realize," he said. "So you sacrifice bringing a new life into the world in order to prolong an old one?"

She started to protest, but he cut her off.

"I regret your presence here, Ms. Hobson. Clearly, you have problems of your own. This is not your fight."

"I think it *is* my fight," she said. "My mother's in there. And you want to shut the system down. Don't you realize how many of them would die?"

His eyes softened, but only for a moment. "And I suppose you think it's all right for the poor to die," he said quietly.

"Of course I—"

One of the others wheeled a television into the room.

"We're on," said the newcomer. "Check it out."

The screen showed the Golden Life facility as seen from outside, where many people—newsmen, police, and military—were milling about. Kim found it eerie to see the live picture and to know she was inside the building on the screen.

Then the view switched to a commentator. Carlos turned up the sound.

". . . growing unrest as the poor react to the crisis with riots and protests. Carlos Calderon, whoever he is, has become the catalyst for the worst episode of civil unrest in memory. His demands that high-tech care for the elderly be provided free of charge to the poor, have brought to the surface widespread anger and discontent that must surely have existed for some time. Calderon was simply in the right place at the right time with the right message.

"Many cities have initiated curfews in an effort to control street violence. This is proving largely ineffective. Meanwhile, Congress is meeting in special session to explore long-term solutions to this very divisive issue."

Kim glanced from the screen to Carlos. The whole thing seemed to amaze him.

"I can't believe it's gone so far so quickly," he said. "I wonder if it will make a difference. I wonder if—"

An explosion rocked the building. The lights flickered, and Kim gasped, but they came back on again. The sound of running feet came from the hallway.

"They're in the building!" one of Carlos's men reported. Carlos nodded, and those who remained in the room dashed out, weapons in hand.

"I guess we have our answer," Carlos said, turning to Kim. His eyes were sad as he moved to the switch his men had rigged to the facility's power system. "I had hoped—"

Gunfire sounded from somewhere nearby, followed by soft popping

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noises. The gunfire ceased.

"Please," Kim said. "You've gotten their attention. You've made them think. Isn't that what you wanted?"

A man had appeared in the doorway. He raised a tranquilizer gun and fired. Carlos grunted. His hand hovered above the switch, but before he lost consciousness, he looked into Kim's eyes, smiled, and withdrew the hand.

Men were rushing into the room then, grasping Carlos roughly, jerking him to his feet.

"Don't hurt him!" Kim blurted. "He could have killed them. He didn't. Please don't hurt him."

But one of the men was slapping him, trying to bring him out of his tranquilized daze. "You've started a world of trouble, pal. But you'll pay."

An officer entered the room, glanced at Carlos, and then spotted Kim. He crossed to her. "I'm sorry about all this, ma'am," he said. "Are you OK?"

"No," she said. "I'm not OK at all."

It was a breezy autumn day, four years later, when Kimberley Hobson heard of the impending parole of Carlos Calderon. Ironically, the news came over the radio as she drove to visit her mother at the Golden Life Alternative Facility. As she parked the car and walked up the steps of the visitor center, her thoughts returned to that day four years ago when so many changes had been set into motion.

"Good afternoon, Ms. Hobson," said the receptionist. "I'll be right with you."

She waited. The place was abuzz with activity, as it always was these days. With the number of patients skyrocketing under the new program, the staff had to scramble to keep up despite its own hundredfold increase.

Kim thought of Carlos. She decided to visit him after his release, to let him know she bore him no malice, that in fact she was grateful to him. So much in her life she owed to him. While he had become a folk hero, the years had changed her life in ways she could hardly measure. She looked forward to the chance to thank him.

"Ms. Hobson? We can take you now."

By now the procedure was routine, and Kim hardly noticed as the electrodes were inserted. Reality vanished. She stood in a busy office where data terminals flashed and the hum of communication links provided a constant background noise.

"Hi, Mom."

Her mother looked up from the terminal where she was working. "Kim! I wasn't expecting you. Let me finish this up. Only takes a moment."

Kim waited while her mother's fingers danced nimbly over the keyboard. In a few seconds, she was through.

"Let's get out of here," her mother suggested. Kim followed, and outside the door of what appeared a typical office lay a vast stretch of beach, the water blue, the sand white and sparkling.

"Keeping you busy?" Kim asked.

Her mother chuckled. "You could say that. That finishes my secretarial work for the day, but tonight I have an art class to teach, and tomorrow I'm being interviewed for a government position in the records department. Sometimes I wonder how the outside world

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ever functioned without us."

The breeze off the sea was sweet.

"It sure beats the way things were," Kim commented.

"I'll say. At least I'm carrying my own load now. And I feel useful—you know? That's important. Life is too precious to waste it the way I did as Tamina. That was such a self-indulgent time."

They had walked a good distance down the beach before Kim felt she was ready. She stopped and turned.

"Mom, I . . . I've got some news." She warmed at the spark of interest in her mother's eyes. "I . . . ah . . . I've met someone. A man—a wonderful man. I know it's all very sudden, but . . . we're getting married."

Kim watched her mother's face for reaction. There was excitement at first, but then a cloud passed over her features. "That's wonderful, Kim. It's about time you settled down. I just wish I could be there for the wedding."

Kim smiled. "You can," she said, taking her hand. "We're having it here." ■

●The public must recognize that a risk-free society is not only impossible, but intolerably expensive.

Daniel E. Koshland, Jr.
(Ed., *Science*, 4/7/89)

●Certainty generally is illusion, and repose is not the destiny of man.

Oliver Wendell Holmes

●If citizenship had to be earned, a lot of people would be in big trouble.

Kelvin Throop

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Probability Zero

SELF-LIMITING

Dr. Robert L. Forward

There are no millionaires on Xanax.

It is, however, easy to make a living on Xanax. Lord Melcor insures that. When a young xanit leaves the hatchery, he is apprenticed to a tradesman, who shares his dwelling and teaches the apprentice his trade. When the tradesman dies, the young xanit takes over the dwelling and the trade. By applying a little effort, the zorins flow in. Most of the zorins have to be spent on necessities and taxes, but Lord Melcor is easy on his people, and there are always some zorins left to go into the money pit for use in old age.

As the years pass by, the money pit slowly fills with stacks of 100-zorin coins stamped with the likeness of Lord Melcor. The coins are a lustrous silvery gray, made from a precious metal extracted by magical processes from rare and poisonous ores by Lord Melcor's alchemists.

By middle age, the average xanit has over a thousand 100-zorin coins in his money pit. About that time he is assigned an apprentice. For a few years, the work is harder, since the new apprentice must be taught. But soon the apprentice takes over and it is time to retire. It is now the time of life for sitting on eggs, while playing long games of pastil with other retired xanits, and most fun of all, telling stories of the old days and the far-away places to young hatchlings.

Fortunately for xanits, the end comes swiftly. One morning, late in life, a xanit rises from sleep to see that his wrinkled skin has turned from a healthy green to a dull grey. He knows then that he has only one day to live, and will die in his sleep that night. The xanit takes the last of the zorins out of his money pit, gives a generous bonus to his apprentice, and then goes out into the streets to give the rest of his money away.

It is not easy to give money away on Xanax. The average xanit, when asked, will reply that he has enough. But occasionally, there will be some that have suffered an illness or accident, and whose money pit does not have enough zorins. They tell the giver how much they need and he willingly gives it to them, for there is no dishonesty and no

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greed on Xanax. . . .

Then . . . something went wrong in the development of an egg . . . and Queed was hatched. Queed made it through the hatchery and his apprenticeship without incident, but when his mentor turned grey and set to the task of giving away the last of his money, Queed wasn't satisfied with his generous bonus, but lied and said that he needed all of it. The mentor believed him, and gave Queed all of his fortune.

The next night, Queed expanded his money pit. A typical money pit would hold about a thousand 100-zorin coins. Queed made his money pit ten times bigger. When full, it would hold a million zorins worth of 100-zorin coins. Queed's greedy body vibrated in ecstasy at the thought of being a millionaire. He was appalled, however, when he saw that his two bags of money only covered one corner of the deep pit. He would have to find a faster way of making money than working at his trade. Then Queed thought of an idea, an idea so foreign to Xanax that there wasn't even a word for it. Queed would "rob" the zorins from the money pits of his neighbors.

Once Queed had made this breakthrough in dishonesty and greed, the bags of coins in his money pit grew rapidly. Each day he would walk the streets until he saw a middle-aged tradesman leave his dwelling to go on some errand. Since Xanax dwellings do not have locks, Queed would simply walk in and take the zorins from the money pit. He didn't bother with the smaller coins, but only stole the massive silvery grey 100-zorin coins.

Each night after a robbery, he would go to his money pit and get out his rapidly growing treasure. The coins were warm. He played with them, and stacked them, and counted them. Then, he would put them back into the large bags that held one thousand coins each and return them to his money pit. Soon, there were nine bags arranged around the perimeter of the pit, with a hole in the middle for the last bag. When that hole was filled, Queed would be a millionaire.

The next day, Queed was very lucky. He saw a prosperous middle-aged tradesman and his apprentice both leave a well-appointed dwelling. He quickly went inside and scooped stacks of 100-zorin coins from both money pits into his bag. As he hurried back to his dwelling with his heavy load, Queed was overjoyed. The bag of silvery gray coins felt much heavier than the ones at home. He entered his dwelling, and leaning over the money pit, he gloated as he dropped the bag of silvery grey coins into the hole that was waiting for it. Queed could hardly wait until it was nighttime and he could take out all the coins and count them. He was now certainly a millionaire!

As the heavy bag of silvery grey coins made out of pure plutonium 239 dropped into the waiting hole, the money pit went critical and exploded. . . .

There are no millionaires on Xanax. ■

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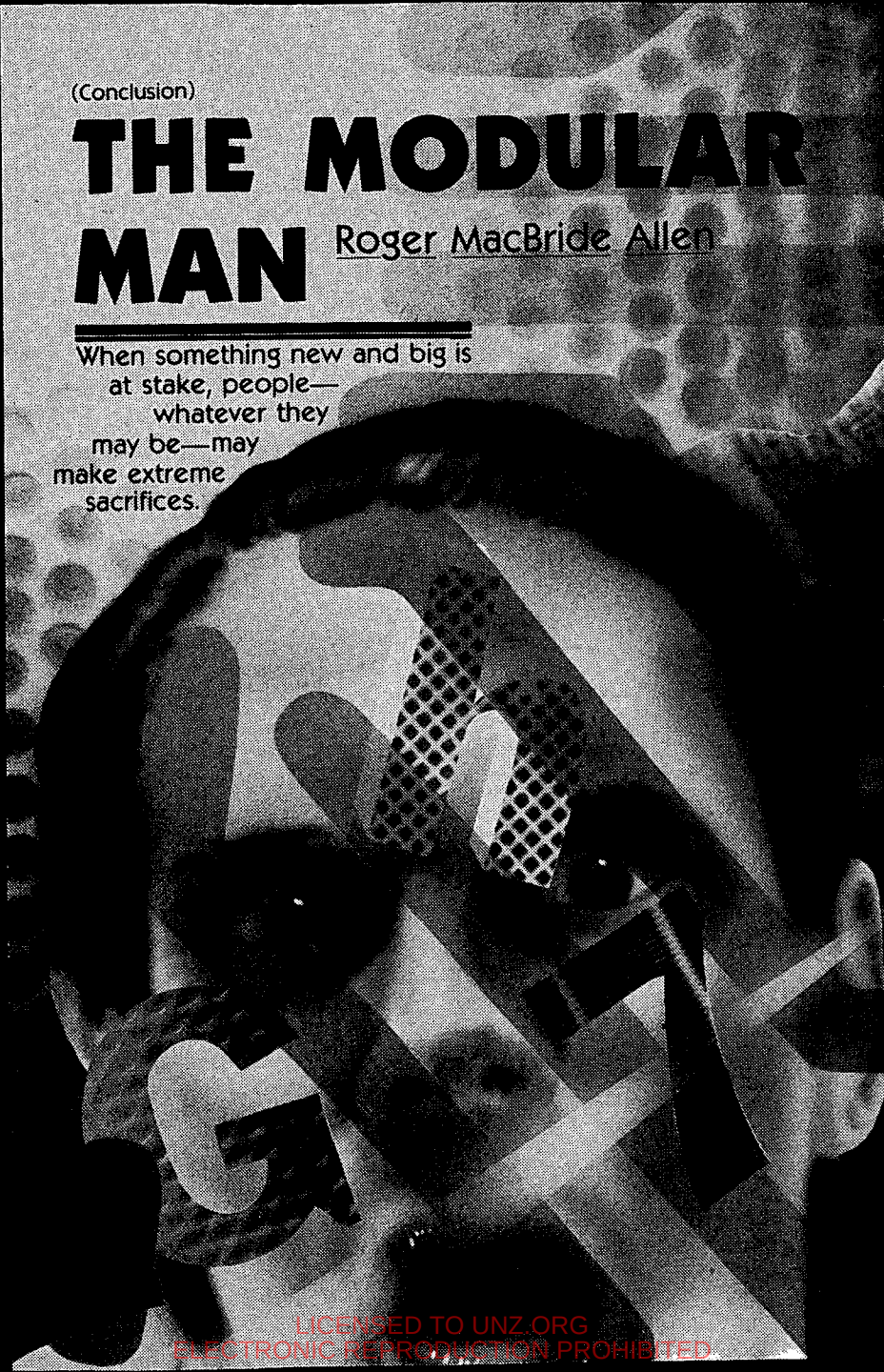
(Conclusion)

THE MODULAR MAN

Roger MacBride Allen

When something new and big is at stake, people—whatever they may be—may make extreme sacrifices.



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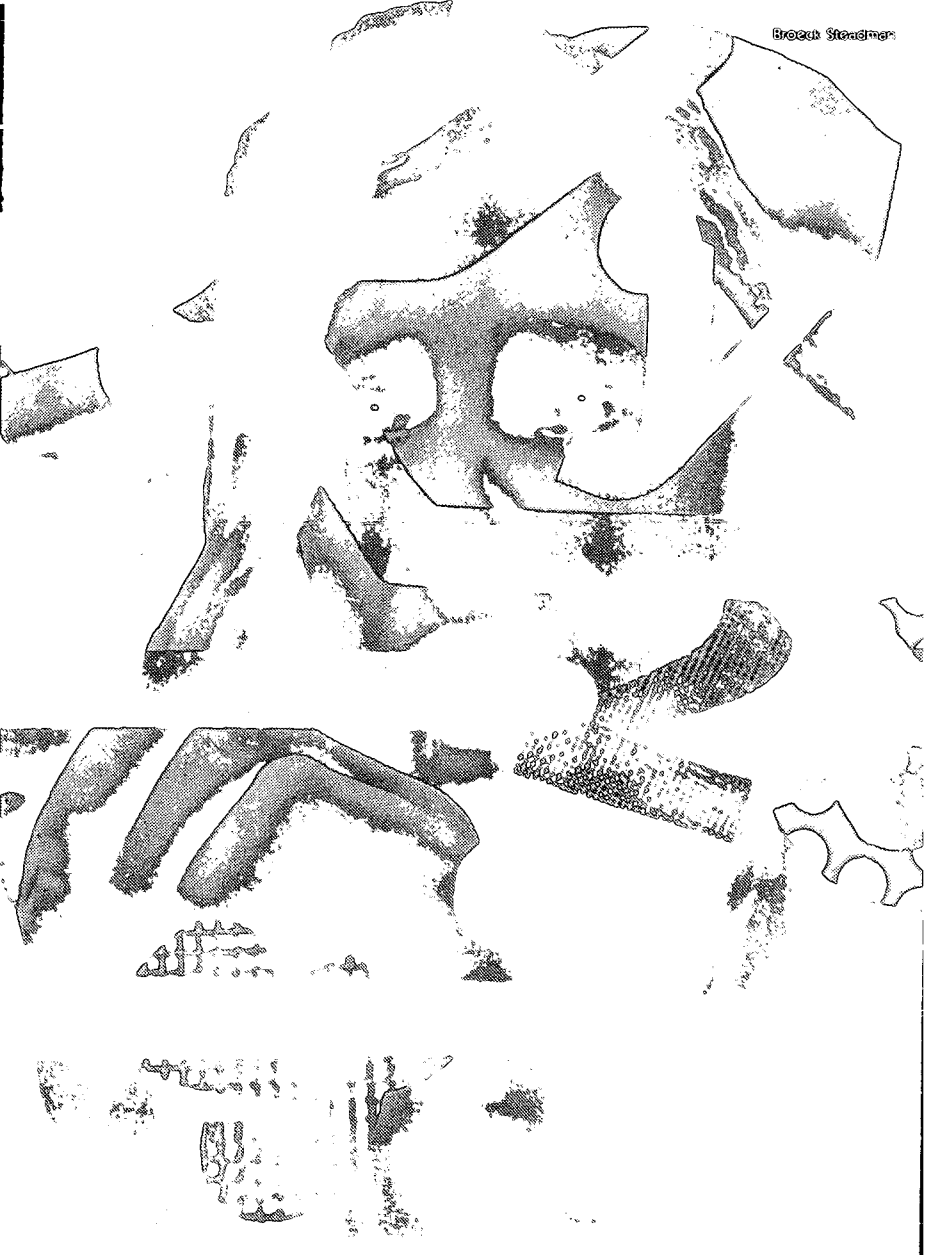

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Synopsis

The story opens in Washington D.C., in the year 2039, as police officer **Phillipe Sanders** *is sent to the home of* **Suzanne Jantille,** *a noted criminal lawyer forced to retire on account of severe injury due to an accident six months before. Her husband,* **David Bailey,** *was also seriously injured in the same accident. He died three months after the accident. Since then, Suzanne has lived as a recluse. Phil warns his partner on the arrest,* **Lu Anne Johnson,** *not to be startled by Suzanne's appearance. It is possible that she is now a cyborg, or even a remote person.*

Phil, usually assigned to the police department's robotic servicing department, is sent to see to it that a rather unusual arrest is properly carried out: he and his partner have been ordered to arrest **Herbert,** *Suzanne's mute and distinctly non-humanoid home maintenance unit (HMU) robot. Herbert stands accused of the murder of Suzanne's husband, David. Suzanne meets with the officers. Phil and Lu Anne are taken aback—she is indeed a remote person.*

But that is of no consequence at the moment. The arrest warrant Phil has been sent to serve accuses David Bailey of copying his mind—or, as it is called, mindloading *himself—into Herbert's brain. Mindloading a human mind has been illegal for years, but all robot minds are based on copies of old mindloads, done on volunteer terminal patients, or on loads from animals. The process of mindloading is always fatal to the subject in question. If Bailey copied his mind to Herbert, he therefore destroyed the original in the process.*

In effect, Herbert the robot is being arrested on a charge of murdering himself. This in spite of the fact that Herbert is incapable of speech, and has shown no indication of human intelligence whatsoever. Suzanne has lived with him in the months since David's death and has seen no indication of human behavior.

Unconvinced of the propriety of the charge against Herbert, and concerned that there is more charade than justice about the case, Phil leaks all the information about the situation to a Washington Post *reporter, a rather determined young woman named* **Samantha Crandall.** *Phil sends the information to her by handing it to* **Clancy Six,** *one of a team of errand-running robots working at the Washington* Post.

According to the files Phil has leaked, US Attorney **Julia Entwhistle** *needs a case to establish a precedent. Entwhistle holds that David Bailey is attempting to live on past his own death, something that many might wish to do, making inheritance and property law almost impossibly complex and allowing some people to live almost forever, accumulating wealth and power at the expense of others.*

Sam convinces her boss, the rather irascible **Gunther Nelson,** *that she should run with the story, though it seems at first to belong in the nut file.*

Suzanne Jantille decides to take on Herbert's case, though she flatly does not believe that her husband's mind still lives on. She too is concerned with precedent, and worried about what the case will do to limit the rights of cyborgs, who are already something of an oppressed minority. Many cyborgs have

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wiped out their life savings in order to buy replacement body parts. They are regarded as street people, bums. Wealthier persons with organ replacements manage to keep their transplants quiet.

Suzanne visits her client, Herbert, at the police station, only to find that he has been locked not in a cell, but in an evidence room, where he has set himself to work tidying up—to the detriment of several pieces of evidence. Suzanne raises a fuss and insists that he be treated like the other prisoners.

In the course of the visit to her client, Suzanne's circumstances as a remote person become clearer—for it is not she who has visited her client, but a robotic body called a remote unit. *Suzanne, paralyzed from the neck down in a car accident, has remained at home, operating the remote via neural implants. The system uses radio links between her and the remote unit out in the field. Ironically, it is the police sergeant's unthinking effort to treat her as a person that reminds her just how inhuman she has become. No tears will ever roll down her perfect plastic face.*

Meanwhile, Sam Crandall attends a press conference and asks some embarrassing questions of Julia Entwhistle and Police Chief **Joshua Thurman.** *She asks why a vacuum cleaner has been arrested for murder. She manages to cause every bit of trouble that she hoped. Sam later meets with Phil Sanders. Phil explains the process of mindloading to Sam. Though previous mindloads only managed to transfer a few percent of the human mind, David Bailey did make significant advances before his death. He might well have managed a complete mindload. Phil points out some tantalizing evidence that suggests that it is just possible that David Bailey's mind—or at least some form of it—is indeed hidden away inside Herbert's body.*

Phil Sanders tells Sam that Suzanne Jantille is a remote person and explains how a remote person system works, and the severe limitations of living as a remote. He reveals that his father was a remote person. Helping his father was how he got involved with robotics.

The next morning, after her story runs; Sam feels a bit of a letdown. Her boss, Gunther, prods her into pursuing the story. She attends the preliminary bail hearing. **Theodore Peng,** *a lawyer in the US attorney's office, is appointed to handle the prosecution of the case, though his instincts tell him that Julia Entwhistle's courtroom strategy will backfire. He and Suzanne Jantille square off for the first time at Herbert's bail hearing. There is something of a stir in court when Suzanne Jantille's remote unit and Herbert the vacuum cleaner come into the room. A large crowd, made up in part of rather seedy cyborgs, fill the courtroom.*

Both lawyers claim that they will be able to prove Herbert's humanity—and both sides are at least partially bluffing. The judge is deeply suspicious of all parties on both sides of the issue. He rules that the question of Herbert's humanity must be resolved in a new hearing before anything else can be decided. He gives the parties one week.

After the hearing ends, Suzanne hurries home with Herbert. Exhausted by her first real excursion outside the house since she became a remote, Su-

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zanne powers down her remote without first caring for her bio-body, although it is rather frail.

Next day, Sam Crandall gets a deep background interview with Ted Peng, in which he admits his private ambivalence over the case. Assuming that Bailey has mindloaded himself into Herbert, then Herbert is *half human and half machine—but the society and the law cannot accept any such grey area. Herbert must be declared either all human or all machine, or else cyborgs will inevitably become second-class citizens. Peng's boss, Julia Entwhistle, firmly believes that the right to survive past death must be denied, or else society will split into wealthy, immortal, cybernetic "haves" who eventually accumulate all the wealth, leaving nothing but poverty for the short-lived "have-not" majority of the population.*

Suzanne awakens the next morning, stiff and cold, with a worsening cough. She begins to notice certain oddities in Herbert's behavior. He is following her from room to room, although she has not ordered him to do so. Spooling through her messages, she finds one from Sam Crandall and agrees to an interview. During the interview, Suzanne says that she urgently needs help in proving something she does not believe in herself—Herbert's humanity. Sam agrees to introduce Suzanne to her source on technical robotics. She does not quite have the nerve to reveal that her source was Phil Sanders—Herbert's arresting officer.

Suzanne is at first most upset to find out who the source is. For his part, Phil is alarmed by the symptoms that Suzanne's remote unit displays. They are symptoms he recognizes from his father, hints of serious illness in the bio-body. Suzanne agrees to take better care of herself, but is not very convincing.

Suzanne explains what she wants from Phil: confirmation one way or the other, that David Bailey is indeed inside Herbert, albeit unable or unwilling to contact the outside world, and some sort of lead on what the US attorney's office regards as evidence of murder. Alternately, she would like to find out if the Feds are bluffing.

Phil opens Herbert up and sets to work. He quickly confirms that David Bailey did in fact attempt to mindload himself into Herbert. It is still unclear if the attempt succeeded. But it at least appears possible that David's mind is in there.

Phil can see that Herbert was built for the purpose of receiving a full mindload. Herbert, in effect, has two brains. He has a fairly standard robotic mind and brain that are operating his body, and a far larger and more complex overbrain, clearly intended as a receptacle for a full mindload of David's mind. But there is no way to know if David's mind has been transferred. Phil finds a damaged area in the linkage between the two brains. The linkage is effectively burned out, and the overbrain has no way of connecting with the outside world.

Phil discovers that it was the attempt to switch control of Herbert's body from one brain to the other that caused the burn-out. David's body had to die before David's mind could reawaken in control of Herbert's body. But a miscalculation caused David's mind, in Herbert's body, to be in control of David's

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brain-dead body, irrevocably linked to it by a mindload cable. David's own desire to live made it impossible for him to will his own heart to die and shut down his bio-body. His mind was trapped, linked to two bodies, but unable to control either one.

And yet, somehow, Herbert did manage to sever the links between the bodies.

The only possible explanation is that David's mind, in Herbert's body, found a way to write a program and route it to Herbert's body. In that way, David-in-Herbert forced Herbert to yank the mindload cable free and cut off the link between David's mind and his body. David-Herbert cut the brain-body link.

In short, Sam and Phil have proved that David did *mindload to Herbert. But in proving it, they have further proven that David-Herbert deliberately acted to end the life of David Bailey's body.*

Herbert did indeed murder David.

PART IV

CHAPTER THIRTEEN

Body and Soul; Together, Apart

Chief Thurman sat in the visitor's chair, devoutly wishing he could be somewhere, anywhere, else. When the chief of police receives a six A.M. call at home summoning him to a seven A.M. meeting with the US attorney and her assistant, it is unlikely to be good news. And it sure as hell wasn't this morning. He wasn't quite clear, but from what Entwhistle has said so far, it sounded like they had put a tail on someone.

Julia Entwhistle leaned forward slightly to continue reading the one-page report that sat in the center of her otherwise empty desk. Theodore Peng stood behind her, calmly looking down at the page as well, carefully avoiding Thurman's eye. "Crandall remained inside at the Jantille home for approximately one hour. Samantha Crandall and Suzanne Jantille then left Jantille's house and proceeded to a rage cage condo building on 14th Street. A check of the residents of that building turned up one Patrolman Phillipe Sanders. By an amazing coincidence, he was the arresting officer in the case, assigned to that duty by the chief himself in view of Sanders's extensive experience with robots. Jantille departed 14th Street late last night. As of our last report half an hour ago, Crandall was still there." She pushed the paper across the desk toward Thurman and leaned back in her chair.

Chief Thurman did not reach for the paper. He resisted the urge to shift in his seat. Maybe he *felt* uncomfortable, even scared, but it would not be smart to *act* that way just now. Not with the dragon lady visibly lusting after his very soul. "That's no crime," he said in what he hoped was a firm voice.

"No, but it sure as hell goes against departmental policy," Entwhistle said, her voice turned sharp and hard. "And I think it gives us a damn good idea who leaked the original information to Jantille, wouldn't you say? But where did he get it? Did *you* give him the information? Say, run off copies of the case datacubes and hand them over?"

Thurman felt a block of ice materialize in his stomach. Had she just got lucky on the first guess, or did she really know? *It's all very well for me to try and protect the department occasionally,* Thurman thought, *but that's over.* After all, he had engineered the leak to make

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sure press attention focused on the US attorney. That was accomplished now. Time to cut his losses. "I didn't give him anything," Thurman lied. Thurman wondered if his career was about to go down in flames, here and now. "What the hell were you following Jantille for, anyway?" he asked, hoping but not expecting to steer the conversation into safer areas. "Isn't *that* against departmental policy—investigating opposing counsel? It better not have been any of my people—"

"FBI," Peng said, speaking for the first time. "Madame Entwhistle didn't want to use D.C. cops. And we weren't tailing Jantille. We were watching Crandall, and quite legitimately. After all, she *did* leak information from a federal document. Certainly that's cause for investigation—though I think we can call off the tail now. We know what we need to know. Sanders has to be the leak."

"So what are you going to do about it?" Thurman asked.

Entwhistle seemed about to reply, but Peng spoke before she had a chance. "There isn't a lot we can do, realistically. I can think of about a half dozen actions we could take that would be perfectly *legal*, but the trouble with most of them is that they wouldn't help us, and might even hurt us more than they would hurt the defense."

"What do you mean?" Entwhistle asked, turning her head to look at Peng. He stepped around her chair to stand by the side of the desk. Thurman found himself wondering if Entwhistle was aware of how completely Peng could lead her at times. "We lean on Crandall to reveal her sources, get a judge to try and force her to talk, and then get her on contempt. There are recent precedents. It seesaws back and forth all the time, but it seems to me that in the last year or two, judges have been leaning back toward the idea of contempt citations for reporters who don't reveal their sources on leaked documents. We could throw her ass in jail until she talks. *That* will get her off the story."

"Wait a second," Thurman protested. "I thought you just got through saying you knew Sanders was the source."

"Maybe *we* know the source is Sanders, but *she* doesn't know we know, and anyway we can't prove it," Entwhistle said. "None of that matters, though. The contempt citation just gives us something to beat her over the head with. And once we get her to talk, or get the proof we need some other way, then we can yank Sanders's badge."

"Why wait?" Peng asked rhetorically. "We've got the FBI report on his clandestine meeting with a reporter and the opposing counsel on a case with which he was involved. We could call it interfering with an ongoing investigation. I don't know if that would be a strictly accurate description of the circumstances, but we could probably make it stick. It would be enough for the chief to fire Sanders, or at least put him on administrative leave or suspension."

"Sounds good to me," Entwhistle said. "Why can't we do that?"

Peng took the chair next to Thurman, and the chief watched him carefully. This guy surely knew how to handle Entwhistle, and it was a skill Thurman devoutly wished to master.

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"Because the second we make any kind of play like that, it would blow up in our faces," Peng said. "Fire Sanders, and boom, he's a martyr, thrown off the force for trying to help a poor old widow lady seek justice—and he'll have got a completely free hand to work with her any way he can, besides having a grudge against us. Right now he's got to be hesitating a bit, being careful enough to try and protect his job. Even if we could find a judge willing to slap a contempt citation on Crandall, it would just make her a crusading journalist. If we try and get her to reveal her sources, just for the sake of harassing her, that will turn around and bite us too. She wouldn't talk, she's not the type. Then the judge would have to throw her in jail. How much bad publicity would that give us? Her editor would put every reporter he had on the case. *Any* legal action we take against Crandall or Sanders will almost certainly backfire."

"So you're saying we do nothing?" Entwhistle said.

"We do nothing *public*," Peng said. "Privately, I would say that the chief should instruct Sanders to stay away from these people until the case is over."

"I can *suggest* that," Thurman said, "but I can't order it. I can't control what my people do in their off-duty time, as long as they don't break the law."

"Well, my guess is that he's broken a few laws already by leaking that data," Entwhistle said. "God knows how he got the information, though. Probably he just managed some unauthorized access to the police computer net and copied the datacubes."

Thurman tried to hide the fact he was breathing a sigh of relief. Obviously she *didn't* know how it happened.

"Probably," Peng agreed. "And maybe if we spent enough time and money and hired enough experts to track it down, we could prove that. But maybe not, and the damage has been done anyway."

"Can't we take some sort of action against Jantille to prevent her from using evidence that was collected illegally?" Thurman asked.

Entwhistle shook her head. "To hear a familiar refrain, nothing that we could make stick," she said. "Judges cut the defense a lot of slack on evidentiary rules, and they've been getting even slacker in the last few years." Entwhistle drummed her fingers on the table. "So I suppose we just have to take our lumps and like them. Meanwhile the opposition knows everything we know."

"And the defense knows exactly what we *don't* know," Peng said. Thurman thought he heard just a trace of emphasis on the word "defense," as if Peng were gently chiding Entwhistle for being unsporting enough to call Jantille the opposition.

"What's that supposed to mean?" Thurman asked.

Entwhistle frowned. "It means they have probably figured out that we can prove Bailey, in Herbert's body, did the murder—but that our proof of his *humanity* is pretty much nonexistent. They know we're bluffing."

"I blew that in court," Peng agreed unhappily.

"Not on your own," Entwhistle said. "I sent you into court with the wrong tactics. We were bluffing, and the judge called, that's all. It's much too soon to

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be committed to proof on the humanity issue, but there we are. At least the other side is committed to the same thing. Even so, as of right now, Suzanne Jantille is going to walk into that hearing with lots of advantages."

Chief Thurman leaned forward in his chair. If he wanted to keep their minds off the leak, he needed to give them something else to think about. Suddenly Entwhistle's words gave him an idea. "Jantille isn't going to walk into that courtroom," he said.

Entwhistle's head snapped up, and she looked at him sharply. "Why not? Legally, there's nothing we can do to prevent her showing up." It wasn't hard to imagine a trace of regret in her voice. Entwhistle wasn't afraid to fight dirty once in a while.

"She's not walking in there for the same reason she's never set foot in there yet," Thurman said eagerly. "She's a remote person. She's never left her own house since they wheeled her home from the hospital. Think you can do something with that little fact?"

Peng and Entwhistle stared at him in stunned silence. At last Entwhistle smiled, and somehow Thurman found her pleasure far more disturbing then her anger. "Chief," she said, "that is one hell of a loophole. Every once in a while it's worth having you around."

Samantha Crandall opened her left eye and found herself staring at an unfamiliar ceiling. It took her a minute or two to remember where she was, and how she had gotten there.

Phillipe Sanders's bed, that's where she was. And she had gotten there alone, damnit. Phillipe, gentleman to a fault, had assured her his couch folded out into a perfectly good bed and he'd be fine there. Oh, there were definitely some subterranean sparks flying between the two of them, but Phillipe was not about to confess to any such thing. *And, apparently, neither am I*, Sam told herself. *Or else why did I wake up alone?* Maybe physical intimacy so early in a relationship was frowned upon these days, but at the moment Sam found herself wishing she had had the nerve to fly in the face of fashion.

Maybe Phillipe was every bit as eager and interested as she was, and simply hadn't felt last night was the night for it. Searching for clues to a murder inside a comatose robot's brains was not exactly the height of romance. It had been exhaustion, not passion, that had made Sam long for a bed the night before. Now that she thought about it, maybe last night would not have been such a good one for sex, to put the matter bluntly. Her brain was muddled and upset by the complicated and disturbing things they were learning, and Sam's mind would not have been on what she was doing. That was no good way to start things off with a man.

She got out of bed and smiled ruefully as she padded her way into the bedroom's adjoining bathroom. She peeled off the T-shirt she had borrowed from her host and started the shower going. Judging from her ample experience in romantic disasters, having her mind on something else at such times was generally a good way to *finish* things with a man, forever.

Maybe taking it slow wouldn't be such a bad idea this time.

* * *

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She emerged from the shower, her nose twitching to the smell of cooking bacon and hot coffee. She dressed, a bit reluctant to put on yesterday's clothes again, and made her way to the main room. The fold-out bed was already closed up, the living-room area neat as a pin. No question but this was a tidy man—almost an alarmingly tidy man—that she was dealing with.

She walked into the kitchen to find Phillipe working at the stove, looking remarkably dapper for someone who had spent the night on a couch. He had put the hall bathroom to good use, gotten himself showered and shaved and squeaky clean. "Hi there," he said. "Not many alternatives in the refrigerator just now. Haven't had a chance to order any groceries. I had to scrounge a bit to come up with this."

"No, it smells great," Sam said. "Just what the doctor ordered." She spotted the coffee pot and two mugs sitting on the counter and helped herself to a cup. "To tell you the truth, it's a bit of a relief to hear that you have to scrounge and that you forget things once in a while. I was beginning to wonder if there was anything you didn't do perfectly."

Phillipe grinned as he transferred the bacon to plates, served out the eggs, and set the dishes on the kitchen table. "Believe me, there's plenty of things I don't do right. Starting with our mechanical friend out there. Sit down and eat."

Sam dug into the eggs greedily. A nice old-fashioned breakfast. Phil poured her a glass of juice from a pitcher on the table, and she took a sip. "I don't know how you could do any better than you have done," she said. "You made incredible progress last night."

"But I didn't get us any closer to Bailey," he said. "He's in there, I'm convinced of that. But we're not any nearer to him."

"Isn't there any way to, I don't know, run a phone line in?" Sam asked. "Can't you hotwire some sort of connection to him? Hook a speaker to his speech center and a mike to where his ears go?"

" 'Fraid not," Phil said, sitting down to his own breakfast. "The way he's wired up, all of his sensory input is mediated by the underbrain before being passed to the overbrain—and the hookups between the overbrain and underbrain are what got ruined. Nothing can get through there, and there's no other way to reach him." Suddenly Phil looked up and frowned. "Except through the mindload cable," he said. "But that's designed to have a human body on the other end of it, not a loudspeaker and a microphone. It's too generalized a connection to do us any good."

"You mean the cable Bailey used to perform the mindload in the first place?" Sam asked. "You say we can't use it?"

"Right," Phil said. "The problem is that cable doesn't attach to any specific point at either end. Potentially, any point in the bio-brain could link with any point in the robotic brain—but probabilistic and quantum theory prevent that. The cable resembles a long chain of synaptic connections, millions of them, hooked end to end and bundled around each other, almost like an artifi-

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cial spinal cord. Quantum theory forces the artificial synapses to link up through the paths of least combined resistance, so that, for example, the speech centers of the old brain hook into the speech centers of the new one. In effect, the cable learns, *teaches* itself, to link only the proper points in the two brains. You can't just plug a mike and a speaker into a lash-up like that and expect it to work."

"But it worked when Bailey had it plugged into his body."

"Sure. It had a whole neural network to work with, with millions of connections to make simultaneously. The system will try a million path links at once, but only one in a million will have a good enough potential match. Then it tries to link all the remaining paths, and maybe one more match gets made. Then again, and again, and again, a million times, until every path is matched. You can't do that by hand. You can only use that kind of technique in a complex neural system that can automatically do that kind of recursive linking."

"Hold it," Sam interrupted, holding up her left hand as her right wielded a fork, chasing the last of her eggs around the plate. "Cut the double-talk. What you're saying is that the only way to hook him up is through the mindload cable, and the only way to use that cable is to patch it into a complex neural network. So why can't you use that cable to patch right back into Herbert's underbrain?" Before Phil could answer, she held up her hand again. "Wait a second. I think I know. Because Herbert's neural net, his nervous system, is geared to his body form, set to roll wheels and run six legs and a built-in vacuum cleaner. Without the movement interpreters and translation routines Bailey built into the interconnectors, it can't handle commands that are intended to move a human body around. And those interpreters and routines got burned out."

"Exactly. Right on the first try."

Sam put down her fork and picked the last strip of bacon off Phil's plate. She popped it in her mouth and chewed it thoughtfully for a moment. She swallowed and looked at Phil. "So what you're saying is that Bailey's brain can't control Herbert's body because Herbert's body isn't human-form. Well, OK then, suppose we could take that cable and plug Bailey into a human-form robot body—would that work? Would he be able to run that body, move in it, speak and hear through it?"

Phil shrugged, turned his palms upward in a gesture of helpless dismissal. "Sure. David's mind in Herbert's overbrain is issuing commands to run a humanoid body. Plug it into a humanoid robot and you'd be all set. You could do a perfectly standard hookup to the robot body—but so what? It wouldn't work. Bailey's brain is too damned big to fit in anything remotely like a human-form body."

"Who said anything about fitting the brain in it?" Sam said. "Suzanne's brain isn't in the body *she's* running."

Phil stared at her in open-mouthed astonishment. "Wait a second," he said. "Are you saying that—if we—my God, *yes*, he's got enough two-way data channels. We could rebuild the mindload transfer circuits. That'd be easy. All we'd need would be a body, a robotic body that he could run to signal

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to. He could run it like a remote from here, like Suzanne runs her body. I've got all the hardware here. The radio gear, the relays—'' Phil stood up, enthused by the idea, as if he were eager to get started on it right away.

''No,'' Sam said. ''Wait a second. We can't do it that way. At least not at first. Not in court. You'll have to use a cable, a direct hardwire connection. An umbilical.''

''Huh? *Why?*'' Phil looked down at her, very confused. ''Do you have any idea how clumsy that would be? A human-form robot plugged into a cable on Herbert? How would they walk?''

''Slowly and carefully,'' Samantha said with some impatience. ''I know it would be clumsy. But don't you see? We're not just trying to make it possible for David to talk and act—we're trying to prove he's *really there*. If we try to do it with a remote person rig, over radio waves, it'll be a lot harder to convince everyone it isn't a gimmick, a trick. You can't leave Herbert at home and have a human-form robot in the courtroom, answering questions in David Bailey's name. We'd never get away with it. You'll have to have Herbert and the remote robot in court *together*, physically attached to each other, and be ready to prove that there isn't any outside signal being beamed to the robot.''

Phil thought about it and sat back down. ''Hell, you're right. It's miserable engineering, but you're right.''

''So how do we get started?'' Sam asked.

''We find ourselves à robot body,'' Phil said.

''Um, uh, I hesitate to suggest it. I know it's got to have a lot of emotion for you, but—''

''You're about to suggest the remote body my father used,'' Phil said.

''Well, yes,'' Sam said, a bit uncertain how he would take the idea. ''From what you've said, it sounds like it would fit the bill perfectly. Could we use it?''

Phil considered for a second and then shook his head. ''No, it wouldn't work. At least not in the time we have left. The remote unit, the robot body, is half taken apart. It would take me at least a month of full-time work to get it back in operational order.'' He shook his head and made a face. ''I don't mind admitting I'm glad we don't have that choice, but it wouldn't work. We need a fully functional human-form robot, in good working order, one that's capable of receiving orders from an outside source.''

Sam thought for a second and then clapped her hands together. ''I've got it,'' she said. ''I know a body we can use, if we can afford it. We've got to call Suzanne and tell her to get out her checkbook.''

''Her checkbook?'' Phil asked. ''For what?''

''For a Clancy,'' Sam said. ''Clancys will do anything if you offer them enough money.''

Interlude

I have dreamt I am awake too long, or perhaps slept too long in my wakefulness. The silence and the dark that have helped to heal me now begin to harm me. I was too long forced to wakefulness by the relentless sounds and images the robot body forced on me, and the dark quiet brought me peace. But

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now I have been too long without sight or sound, or any outside sensation. My need for rest is over, and yet the sightless silence goes on. Now starved for stimulation as it was so recently starved for quiet, I can feel my mind closing in around itself, inventing its own spurious images and voices, striving to protect itself with hallucinations. False visions flash past my eyes, combining the depth and solidity of real things with the fevered, looming, distortions of a nightmare. People, places, things that are not there materialize, spun from the cloth of my memories and my imagination. Robots dressed as humans fill a jury box. Cyborgs strip off their human parts and demand the right to become complete machines. Rich men buy up the bodies of the poor, sucking the life from them, discarding the poor men's shriveled souls like so many empty candy wrappers.

I am back in my own lab, in my own house, taking all my machines apart; reconstructing them into a killer car that chases me down, hunts me and my wife, and crushes the life out of me. I cannot judge these images. I cannot distinguish the real from the imagined, the sensible from the insane.

There is a stranger circumstance than a nightmare at work. I can feel time, and I know that this too is not as it should be. In the midst of my dementia, I know what time it is, *ceaselessly and precisely. At any given moment I can tell the exact date and time down to the thousandth of a second.*

My sense of time should have been the first thing to go when the hallucinations began, and yet it persists, strong and certain. There is a simple explanation, of course: my mind now inhabits a brain that is in turn governed by the timing pulses emitted by a quartz-crystal chronometer. Somehow this distressing reminder of my existence as a mechanical device does not depress me, but instead offers me a sense of comfort. In the passage of time, at least, I am linked to reality, to the outside world. I cling to time, concentrate on its passage, as a bulwark against the leering madness that surrounds me. Surely they have not turned me off forever. My electrical power will be switched back on, and with it outer reality will return.

At last, 3 days, 9 hours, and 37.832 seconds after my hallucinations begin, I begin to feel something outside myself. A few brief flurries of power, minute wriggles of energy, flit past my inner consciousness. Test power, I conjecture, coursing through the bulk of my inert body. Then nothing for another hour and 8.645 seconds. Then for a flash, a moment, a flicker, I see a new image, make new contact with the outside world—but I see from a new set of eyes. Eyes that look down upon my own robotic body, and a man and woman bending over it. The woman, her face framed with flowing red hair, turns her tired face toward my eyes, and then the image dies. Surely this is another hallucination, but there is something authentic about the image. I do not understand it, but it excites me.

I sense somehow that the end is near.

CHAPTER FOURTEEN
The Last Morning

Suzanne Jantille woke up in a wrenching paroxysm of coughing. At last the fit passed, and she lay there,

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weak and tired, dreading the thought of all the energy it would take to get herself up and moving today. Damn it all. If only she hadn't been forced to fire that damned tech nurse, she might be able to get a little help for herself. But when her cold was still getting worse two days after that long night at Phillipe Sanders's, the tyrannical fool had tried to keep Suzanne from using her remote unit at all. And with the number of things that she needed to do, that was flatly impossible. There hadn't even been time to try and arrange for a replacement nurse.

She winced a bit as she shifted her head and spoke the voice commands to activate her teleoperator helmet. Her voice was sore and raspy, but at least the swelling at her neck was gone. The induction sensors in the teleoperator helmet were able to pick up her commands to her nervous system a little better. Or perhaps she was learning how to operate her body in spite of poor signal reception. It didn't matter. She could function. That was the main thing. The helmet closed around her head, the miniature video screens came to life, she saw the world through the eye-cameras of her remote body. Another day began. Suzanne-Remote stepped out of her charge chair and looked about the room, barely taking time to glance at the huddled form on the bed. There was that moment when she felt the strangeness of looking at herself from the outside, but she firmly told herself she was too busy this morning to get caught up in her usual distractions.

Monday morning. So much to do. Seven o'clock now. The hearing would begin at ten, three hours from now. Were all her arguments ready? Had she covered all the bases? Part of her knew perfectly well that she was merely dithering, pointlessly worrying over things she had already done, fussing over jobs she had finished, focusing on things it was far too late to worry about. But somehow even that was comforting. It was part of her old pre-trial ritual. Never in her life had she gone into court for a major appearance without having a brief case of nerves first. Somehow it felt good to be back in her old rhythms, even the downside of them.

But then her bodies, both of them, robot and biological, were wracked by another fit of painful coughing, one that hurt enough that the pain reflex forced her robot body to double over.

That was strange, Suzanne thought. *I felt* both *bodies that time*. That was the first time *that* had happened since her first days of training to use the remote.

It was the pain, she realized. The pain was there always, reminding her of where her real self was, which vessel truly held her spirit and soul. Try as she might, she could no longer pretend, even for a moment, that the remote, the robot, was her real body. The pain forced her to acknowledge that much. Robots didn't feel pain, or get sick. She was a divided soul.

But this was no morning to concern herself with such things. There was work to do. She forced all her worries, professional and personal, from her mind, and got on with the day. Somehow, that made her awareness of her bio-body recede a bit. She gave her bio-body its usual perfunctory morning care—tucking in the blankets, smooth-

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ing the sheets, checking a few of the feed lines. It was time for the things that truly concerned her this day.

Such as that bandit Swerdlow, the man who owned the Clancys. It had not quite been as easy as Sam had first thought to rent a Clancy, but, ultimately, Swerdlow was motivated by the same thing as his robots. Once enough money changed hands, all was well. Suzanne had been forced to accept a one-year lease at a horrendous charge. Unfortunately, the Clancys were the only robots available that could be readily adapted to accepting out-of-body control. Once Swerdlow figured that one out, he knew he could name his price.

Now it didn't matter. That trouble was two days old, and over and done with. Of more immediate concern was the word she had received last night. The prosecution had notified her of its intention to file an unspecified motion this morning. In other words, they were gearing up to throw her a curve ball, and she had to get ready for it. She bustled down the hallway to her office and sat at her desk. There would barely be time to pick up her client—no, pick up Herbert—no, pick up her *husband*—at Phil Sanders's place beforehand.

Good God, her husband. David. If all went well, this would be the day she would first hear him speak, hear in his own words what it was like to be summoned back from the dead. He was coming back. That thought, *that* idea should have glowed in her mind with the power of the Sun, Moon, and stars—and she had barely considered it. Instead she had only considered his words—or, if things broke the wrong way, the lack of them—as they would affect the proceedings in court. If he spoke, and was coherent, and could relate at least a few details of his life and death, provide even a little verisimilitude to the court, then Suzanne would have won this final battle. David would be proved human and the murder trial could proceed.

Nothing else mattered. How the judge would consider his words, that was the only equation that mattered, the only issue that even entered her mind when she thought of her client.

It was over-detachment, preoccupation, of a very strange sort indeed. In playing her mental game of courtroom-chess, moving all the pieces around, trying to see the game from every angle, she had fallen into the trap of considering her own husband merely as a client, and then compounded her error by assigning her client to the role of a mere pawn, a game piece on the board.

Her own husband. Now, at last, that thought struck her with all the power it deserved. *Her husband*. And he had yet to speak, yet to utter a single sound or demonstrate by any means at all that he was in there. Phil and Sam were still working, still even professing confidence of success, but Suzanne could read the hollowness in their voices even as they made their promises. The odds against their being ready in three hours were long, and getting longer as the time grew short.

With another jolt, Suzanne realized she had not spent much thought on Phil and Sam either. Both had sacrificed, and struggled, on her behalf, and David's, and without their help the situation would be hopeless.

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She thought of them now: Phillipe Montoya Sanders, working almost around the clock all week and all weekend, Samantha Crandall at his side, helping as best she could. The two of them struggling heroically to get Herbert ready for Suzanne's Monday morning battle.

And yet Suzanne had never really considered how much that effort must have cost the two of them, the prices they had paid: Sam's editor, wary of conflict of interest, ordering Sam to turn her notes over to another reporter and telling her to stop filing stories on the case that should have made her career. Phil, shrugging off a rather stiff warning from Chief Thurman to stay away from Suzanne and her case. According to Sam, the chief had made it clear that sticking with Herbert could do no good whatsoever to his future career hopes, or even his current employment status. Instead of taking *that* hint, Phil took a week of his extensive accumulated leave.

He had all but locked himself in his workshop, buried himself in the intricacies of melding Herbert's circuitry with Clancy's.

But none of that had registered. Instead she had thought of legal tactics, courtroom strategy. Was she becoming so machinelike that *all* her emotions were fading away? Two people she barely knew were risking, perhaps destroying, their careers because they believed in her cause. That *mattered*. And she had never even said thank you to either of them. But it would be all right, she told herself. She would make it up to them, somehow. After it was all over.

* * *

"Circumstances," Julia Entwhistle said, "have changed."

"I know that!" Theodore Peng replied. "But this is still wrong, still underhanded. Let me get on with preparing for the case itself. Don't make me do this thing. It will demean Jantille—"

"We are not here to care for the psyches of opposing counsel," Entwhistle broke in.

"—and by extension, by getting *our* hands dirty, it will demean us, demean *you* and your office," Peng shot back.

"That is my problem, and this is my decision," Entwhistle said. "I did not call you in here at seven in the morning the day of a major hearing to ask your permission on this or anything else," she snapped. She paused for a moment and then went on in a calmer tone. "Excuse me. I'm a bit on edge myself. I know you've got last-minute preparations to do, but in my judgment it was more important that I know you have accepted these instructions, and will pursue this motion vigorously. When we launched into this prosecution, we thought that we would be facing an unenthused lawyer representing a mute hunk of metal with no discernible human traits.

"We planned to force the case to trial up against someone who would hand us a precedent in a federal court establishing that robots *can't* be human. Someone who would inevitably blunder into a situation where the judge would have to rule that David Bailey was irrevocably dead and Herbert was a machine. That would be a ruling we could build on, something we could take into the next case, and the next one.

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"Instead we are up against a seasoned, hard-edged professional trial lawyer. Even worse, if our information about what's going on at Sanders's place is reliable, we face a very real chance of going up against an articulate defendant who could conceivably put on a very good *demonstration* of being human. We can't do anything about the latter problem, but we can do something about the former one. I intend to have that something done, and you are going to do it." She picked up a paper from her desk and offered it to Peng. "I am giving you a direct order to make this motion and force Suzanne Jantille to withdraw from the case. No ifs, ands, or buts. Is that clear?"

Theodore Peng stared at the paper in her outstretched hand. He reached out for it, drew back, and finally took it. "Yes ma'am, that's clear," he said. He stood there, holding the paper for a moment, trying to think of any orders he had disliked as much as these.

Samantha Crandall woke up next to the man she was falling in love with, and found herself amazed at just how unromantic a prospect that could be. They were here, together, because on her second night here they had been too tired to go through all the trouble and bother of making up the fold-out bed. That had set the tone for the rest of the nights. Last night, for example, she had collapsed into bed at four A.M., with Phil still hard at work as she fell asleep. They were working against a tight and unforgiving deadline, and sleeping together had been strictly a matter of convenience, not one of passion.

She looked at Phil, gently snoring next to her, and smiled as she revised that estimate. No, they *had* had one night of love—or at least a half-hour of love, two nights ago—or was it three—before they had both collapsed from exhaustion. The days had all faded into one long fog of work. But on the other hand, that lovemaking had been very nice indeed—no, better than nice, it had been wonderful. Maybe tonight—or tomorrow—after they both had time to rest they could do it again. Maybe they could find the time to give their nascent love affair a proper start.

Be that as it may, a half hour's passion had been all they could manage so far. All the days, all the nights, had been dedicated to the maddeningly complex and delicate job of creating a link between Herbert and Clancy. She flexed her fingers and regarded them thoughtfully. She had proved herself a pretty fair hand at much of the intricate handwork involved—including the work that had to be done under a microscope. Assembling the artificial neuron chain modules had been the toughest part, at least for her. She thought of Herbert's inert body in the main room, its outer carapace completely removed, the hardware that had once been his mindload cable hookup now half-disassembled. Clancy Six was on the other table, in not much better shape. Phil and Suzanne had agreed it would be smart to remove Clancy's internal brain, to make it utterly incontrovertible that David, working through Herbert, was doing the thinking. *That* had been a job.

With a snort and a groan, Phil rolled over in bed. Sam had learned enough about him by now to know that was the first stage in his wake-up ritual. Ten

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minutes from now he'd wake up for real and be in search of coffee. She smiled and hopped out of bed, eager to have it ready for him when he woke.

But the wake-up rituals were a bit rushed and forced that morning. Days of time to do the job had shrunk to hours, and would soon evaporate into minutes. Breakfast for each of them was a cup of coffee and an apple, and that was virtually the last food in the house.

The passage of the last few days had worked changes on Phil and his home. Both man and condo had lost all sense of neatness and order. The kitchen was a mess, but the workroom outside was worse. Parts were strewn everywhere. Disassembled machines cannibalized for this part or that sat on all the benches, and the carefully sorted storage racks were a hodge-podge, their contents shuffled and rearranged repeatedly by the search for another gizmo or another gadget.

Sam took a good hard look at Phil as they sat at the kitchen table and drank their coffee in exhausted silence. He hadn't shaved in three days, and his eyes were bleary with exhaustion. He had showered every day, but even that rule was crumbling. This morning he had all but sprinted through the shower stall, barely giving himself a chance to get wet before he was out again, more interested in the water waking him up than getting him clean. She could see something in his face: He was not just committed to finding David inside Herbert—he was obsessed.

Sam was reminded of a story she had covered a few years before, when a little boy in California had been trapped by an improbable accident. His parents had left him alone in their stylish cliffside house, far remote from the city, and had headed into town for the evening. A freak rainstrom, a flash flood, and the house had simply fallen down the cliff in a mud slide.

The boy was buried alive under the house, under tons of mud. But by some miracle, the boy was caught in a corner of his room that did not collapse. Showing incredible presence of mind, he had used his toy walkie-talkie to call for help. By some further miracle, the Art-Int scan gear aboard the first police car on the scene picked up his call and alerted the cop in the car.

Almost immediately the house was the focus of a huge rescue effort, a scene indelibly marked into the memory of anyone who saw the live broadcasts that went on for days. The mud-entombed, collapsed house, the frantic parents in tears, the heavy digging equipment, the worried engineers struggling to find a way to get to the boy without bringing the rest of the house down around him—all framed by a pounding, relentless rain that never let up. It had been five endless days before they got the boy out.

Sam remembered a face captured by the camera, the frantic, determined, sleepless, obsessed face of one of the rescuers at the scene. She did not have to look any further than Phil to see that same look again. But why?

Why did he care so much, and why was she along for the ride? Deep in her heart she knew part of the answer: Phil was here for his father, who had been caught in the same trap as Suzanne, his father, who might have ended up where

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David was now, if the technology had advanced just a bit further.

But why was *she* here? For Phil? That was part of it, certainly. But it did not explain why she had handed off the biggest story of her life to another reporter and risked her career with scarcely a moment's hesitation. She was not the type to abandon her life for her man. She would not do it and Phil would not expect it. No, it was nothing as small or silly as that.

She was here because she cared, too. Because all this was important, because it would decide things. But what things? And what outcome was she trying to produce? Trying to prevent the state from executing an innocent man, yes. But there was more, she knew that. More than she had ever taken the time to examine.

"I'm lost," Sam announced into the numbed silence of the kitchen, perhaps as much for something to say as anything else.

Phil looked up from his coffee in distracted puzzlement, as if he were surprised to see her there. "What do you mean?" he asked with poorly masked impatience.

"I mean I don't know why we're doing this anymore."

Phil gave her a puzzled look. "So that David Bailey can appear in court, so that he can prove that he is alive, so he can't be tried for murder."

"But why the murder charges? I mean even Entwhistle knows that it's a crazy rap. It's a gobbledygook charge, a legal fiction."

Phil nodded tiredly. "What they really want is for a judge to tell them just that. Boom. That makes Herbert abandoned property, and illegal mindload equipment to boot. They impound his tin ass and melt him down to scrap. His *real* crime is in staying alive. *That's* why they want to bust him. They don't want people to survive their own deaths."

"Why the hell not?"

"I've thought about that," Phil said, "and I've read the arguments and the background in that datacube I swiped. It boils down to money. They teach you that in reporter's school, don't they? 'Follow the money'?"

"Yeah, but what money? Bailey was rich, but so what?

"Not *his* money. Follow the pattern of money in our society. It's in the datacube. As a general rule, people tend to accumulate wealth throughout their working lives. After they retire, they live off the interest, or off the principal they've accumulated. They start to disperse what they've accumulated. When they die, the children split the proceeds, death taxes take a bite, and so on—virtually complete dispersal. It's actually fairly rare for a family fortune to hold together more than a generation or two. In the grand scheme of things, that's no bad thing. It redistributes the wealth a bit more evenly, and frees up capital, injects it back into the system instead of leaving it to molder in bank accounts."

Phil rubbed his bleary eyes. "But what would happen," he asked with a yawn, "if rich people never died, never got old or weak? Cyborgs were the first stage toward that. Remotes like Suzanne are the second. Herbert is something very like the third. Entwhistle is looking ahead to twenty years from now. By then, I bet I could fit a robot

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brain as good as Herbert's inside a standard-sized robot body. Call that fourth stage. Maybe after that they'll even be able to do nerve endings, give back the sense of touch and smell and taste. That'll be fifth stage. A perfect human-replica robot body that never grows old, never dies, never wears out.

"But replica-humans will have to be incredibly expensive," Phil went on. "Cyborging costs a lot, and so do remote units. Stage three, Herbert, cost even more. Bailey probably had twenty times the resources I have here, and even so he just barely managed to afford Herbert. I can see that in the engineering. He did the job well, did it right, but I can see a lot of things he did just to save money. Something has to be pretty pricey when a guy like Bailey is forced to watch the pennies. So what happens to society if we get to stage four or five? We're on the way there already, with no one but the rich being able to afford cyborging. Think about all the street cyborgs who've wiped themselves out trying to stay alive. They were the first victims. What happens next? Think it through," he told her.

Sam considered for a moment. "You end up with super-rich immortals and poverty-stricken people who die." She made a face. "Brrr. It doesn't sound like a nice world to me."

Phil nodded. "No, it doesn't. And it's what Entwhistle and Peng are trying to stop before it can get started."

"And they think they can do that by getting a ruling that Bailey is dead? By impounding Herbert and killing him?"

"It would send a pretty powerful signal to anyone else who tried the same thing," Phil said with ghoulish humor. "The Feds want dead people to stay that way, to make sure there's room and wealth enough in the world for the living."

Sam shook her head in befuddlement. "It doesn't seem like such a bad thing to be striving for."

"It isn't," Phil agreed equitably.

"But we're *fighting* them! We're against what they're doing."

"And why's that?" Phil asked with a tired smile.

"Because it's good to be alive!" Sam said. "Because people have a right to live!"

"But do they have the right to survive death?" Phil asked. "*That's* the question here."

Suddenly a light came on in Sam's eye. "No it isn't," she said excitedly. "That's not the question at all. You said follow the money, Phil. OK, then. Suppose we could change where that money *goes?*"

"What do you mean?" he asked.

"I'm not quite sure yet," she said. "Let me work on it. But from what you've said, Entwhistle doesn't care about dead people being alive. She just doesn't want them to have any money. Maybe there's an angle in there somewhere."

"Maybe," Phil said, clearly unconvinced. "But now it's time to get back to work." He stood up, refilled his coffee cup and made his way out to the workroom.

Sam glanced up at the clock as she followed him—7:45 A.M. She was suddenly reminded of college and the last cruel dregs of morning after pulling an all-nighter. The clock would tick down

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through those last few minutes between now and that eight A.M. class where the paper was due. There would come that ultimate moment where you would know whether you were going to make it or not. The sense of impending victory would pump one last dollop of adrenaline through your system, or the realization of defeat would snap down the last of your defenses. They weren't quite at that make or break point yet, but they were close.

Plan A had seen the job as almost childishly simple—just run a cable between two robots. Then there would have been time to run some real tests, to sit down and *talk* with David-Herbert-Clancy, David H.C. for short. Now all that was out the window. The job was far more complex than Phil had imagined. Neither Herbert nor Clancy were really designed for this kind of thing, and Phil had burned up the last three days just trying to build the modifications that would let them talk to each other, that would let David's mind in Herbert's overbrain run Clancy's body. Everything but that goal had been stripped away.

Just like college, Sam thought. You sat down at the beginning, planning to knock off the core ten-page paper in an hour or two and then spend the rest of your time making it beautiful, pulling in the graphics and the illustrations and the bar charts to dazzle the prof. Then 7:45 A.M. rolled around and you were just praying he would settle for an eight-pager instead.

That's where they were right now. Phil was counting on a lot. He was planning on hitting the power switch and having David H.C. wake up at once, ready to go.

Suzanne shook her head. There wasn't any room left in the schedule for failure.

Wiring tests, alignment checks, double-checking the connections that could wreck the whole operation if they blew. Sam could do little but watch as Phil moved quickly but methodically through the last of the job. Sam glanced up at the clock for the hundredth time that morning. The few minutes remaining slid away, until there was not even time for success.

But at last the moment came. Phil set down his tools and looked up at Sam.

"I think we're ready," he said.

The two robots sat next to each other, Herbert lying lengthwise on his table, Clancy sitting on a tall stool facing him. A fifteen-foot cable snaked across the floor, from an ugly conglomeration of hardware bolted to Herbert's carapace into an ugly open hole at the back of Clancy's neck.

There was something distinctly ghoulish, disturbing, about the sight of that thick black cable snaking out of Clancy's too-human body, his blank expression and sandy, obviously artificial hair somehow making him seem realer rather than more artificial. Nothing that looked like *that* could house a human spirit, and yet it was about to do just that.

There was something chilling about Clancy's patently false realism. Sam studied Phil's face as he leaned over the connections to Clancy's neck, checking them one last time. There was much there to see: rugged, tired, unshaven exhaustion, courage, spirit, the experience

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of a half lifetime stamped on his features. There was a book that could be read, and understood. Clancy's face was nothing but blank pages, nothing more than a high-tech rubber doll. How narrow a chasm, how wide a gulf, Sam thought, between the simulation and the reality. Was that distance truly meant to be bridged?

"Here we go," Phil said at last, his voice excited. "That's the last connection." He looked at Sam and took a deep breath. "So let's knock on the door and see if anyone's home."

He reached into an access panel on Clancy's back and flicked a switch. There was a sort of quiver that pulsed through all his limbs, and his head twitched a bit. "OK," Phil said, "that's power to him. Now Herbert." He stepped to the HMU robot and flicked a switch there as well.

There was another flicker of movement—and then a loud popping noise, and Clancy spasmed violently, falling off his stool and crashing to the floor in an inert sprawl.

"Jesus H. Christ!" Phil swore and cut the power to Herbert. He knelt by Clancy and cut his power as well. "The power converter," he said. "The goddamned power converter. I put it in backwards. It doubled the signal voltage instead of halving it. Popped Clancy's circuit breakers."

"It's not serious?" Sam asked, hurrying over to kneel next to Phil.

"No, damn it. It's just stupid. A stupid fool mistake. I put the thing in at four in the morning. No wonder I made the mistake."

"Will it take long for you to fix it?"

"Long enough to wreck our chances," he said bitterly. He let out a sigh and sat on the floor, leaning up against the workbench opposite Herbert. He stared up at the big robot and shook his head as Sam sat down next to him. "Damn it. If I had the chance to start over, I could do it so much *better*. I wouldn't need half the time or gear I've wasted just learning how it all worked."

"Wait a second," Sam said. "Say that again. What is it you're wishing for?"

"Something I won't get," Phil said distractedly as he looked over the damage. "A fresh start, a blank slate. A chance to let me start over again."

"That's it!" Sam said, swinging herself around to kneel in front of Phil and look into his eyes. "*That's* the thing I was looking for when you were talking about money. That's the solution, Phil. The way out of the trap Entwhistle's worried about. A way to protect society from immortality."

Phil looked at her oddly. "You want to maybe explain that?" he asked.

"Just a little while ago you were talking about what comes after David, that fourth and fifth stage stuff. OK. Suppose, just suppose, instead of taking a replica-human's *life* away, you took his *money* away instead? Wouldn't that solve the problem?"

"What? What the hell are you talking about?

"Requiring mindloads like David to make a fresh start. We've made lots of pretty speeches about David being a changed person, a new person. Why not make that legally true? Declare the old person legally dead, let his or her will distribute the wealth. Allow the old per-

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son some maximum bequest—say, a year's minimal living expenses—to the new person, the old mind in the new body. The new person would get a new birth certificate, a new social security number and so on. In the eyes of the law, one person would die and another would be born—or be mindloaded, or whatever you would call it.

"He or she would lose everything but that stipend, just as if the person had really died. Set it up so that if you change bodies, you lose all your worldly goods. You have a chance to start over, to live. You have a shot at immortality, but not at infinite wealth. You'd have to find a new job, work out a new way of living, earn your own way."

Phil nodded slowly, and thought about it for a second. "That's not bad," he said, clearly impressed. "It would mean there was a real cost to body-hopping, a steep one, no matter how rich you were. No one would try dying for tax purposes. It needs refinement, a little tinkering to keep all the loopholes shut, but that's one hell of an idea. It ought to do the trick."

Sam stood up suddenly and started pacing. "I can see it," she said. "I can see it. It would work. Phil, what is there left to do here?"

Phil gestured helplessly. "I've got to reset Clancy's main bus circuit breakers, replace his power converter, and fire the system up again."

"Nothing I can really help you with?" Sam asked.

Phil shrugged. "Help me get Clancy back on the stool, and offer moral support. That's about it."

"OK then." She knelt again and reached for Clancy's arm, and Phil scrambled to his feet and grabbed the other arm. It took some effort, but they got Clancy sitting up again. "There, that's done, but your morale is going to have to function on its own," Sam said. "I've got to get across town to the paper and move on the Fresh Start idea *now*. Talk to Gunther about it."

"But why?"

"Because that's the nature of the news business. The world has a short attention span. Today, *now*, is the moment when the public's attention is focused on the issue of cyborgs and replica humans. Put an idea about them on the table now, and it might go somewhere. Wait a week, and they'll be worried about the next big crisis."

"So what are you going to do?"

"Talk to my editor, Gunther Nelson. First I find out if I still have a job. Then I pitch him on Fresh Start. See if I can get him interested." Sam was excited, the words tumbling out of her. "Maybe he can swing a lead editorial on it, or get some of the broadcast and print commentators to talk about it. If we can launch it right, get it into public debate—"

Suddenly the door buzzer sounded.

"Damn it," Phil said. "She's early and I'm not ready. Yes, house, what is it?"

"Madame Jantille has arrived. She is on her way up."

"Very good," Phil said, although it was no such thing. "Thank yo—" But then he caught himself in time. "You tell me what *that* means," he said.

"What what means?" Sam asked.

"Saying thank you to the house. I've made it a rule in life not to be polite to

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machines. So what does it mean when *I* start being nice to them?" He grinned, and then walked over to the entrance area. He opened the door and saw Suzanne walking down the hallway from the elevator. He gestured her in without speaking, and led her into the main room.

"How is he?" Suzanne asked the moment the door was shut behind her. No preamble, no hellos or good mornings. She was clearly too agitated for that.

"Not ready," Phil said, crossing his arms and leaning back against the workbench. "I screwed up. We tried a power test and I had a two-dollar component in the wrong way. Popped half of Clancy's circuit breakers. I have to install a replacement and try it again. Fifteen minutes, an hour, tops, and I'll be able to power up the connection again. Then I'll have to run some preliminary tests, make sure his motor function is there, that he can speak."

"It's nearly nine A.M. now, and the hearing is at ten. An hour from now is too late. You can't have him ready in time?" Suzanne asked.

Phil shook his head apologetically. "No."

The word hung heavy in the silent room, and Phil could not seem to look Suzanne in the eye.

"All right then, I won't take him this morning," Suzanne said, her voice brisk and efficient. "Can you have him ready by one this afternoon, in time for the afternoon session?" she asked.

"This afternoon?" Phil asked, clearly startled by the question. "Well, yes. Given that amount of time, I could do it. But I thought it was this morning, do or die."

"It was," Suzanne said. "I know Judge Koenig. If *we* had stalled, or requested a delay of any kind, that would have all but destroyed our credibility with him. As it is, he's going to be watching like a hawk for us to try some sort of parlor trick." She gestured at the two inert robots, and the cable running between them. "And you have to admit, this *looks* like a parlor trick, a gimmick."

"And not a very slick one at that," Sam agreed, talking under her breath.

"But the *prosecution* has given us a delay. *They've* asked to present some sort of motion this morning. So it's their fault, not mine."

"Won't they want Herbert there anyway?" Sam asked.

"Probably," Suzanne said. "But I'll do my best to bluff my way out of it." Somehow, some of the briskness faded out of her voice, and a softer tone found its way into her words. "But I was counting on being able to talk with David this morning."

"There isn't time," Phil said. "I'll need every minute I can get after we awaken him. If you can give me until one P.M. I'll use that time very well," he said. "But you should go, now, or you'll be late for the morning session."

"But if you're that close to waking him—if it really could be fifteen minutes—I'll make a call, request a half-hour delay. I want to be here when my husband awakens," Suzanne said.

Phil looked at Suzanne and shook his head with a bone-weary sigh. "Take her in the kitchen, Sam. Explain it to her. Suzanne, you've given me three hours. With that I can make it. But I *can't* do

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it if you're here. Sam will explain it. I've got to get back to work."

Thanks for nothing, Phil, Sam thought. This was going to be one tricky conversation, to put it mildly. Before Suzanne could protest, Sam ushered her into the kitchen, and shut the door behind her. As soon as the door was shut, Sam made a beeline for the coffee. Not that she could even feel the caffeine anymore, but at least doing something with her hands gave her time to think. How the hell could she explain it all to Suzanne?

Sam poured herself a cup of coffee, resisted the reflex to offer Suzanne one, and gestured for Suzanne to sit down at the table. Sam sat down across from her, still not quite willing to speak. The room was quiet for a moment.

"So what is it?" Suzanne finally asked, breaking the silence. "Why can't I be here when my husband awakes?"

Samantha looked at her sadly and shook her head. "I don't think you understand, Suzanne. Phil doesn't even know if that *is* your husband anymore."

"What do you mean?" Suzanne asked, with just a hint of something in her voice that made it plain she had worried on just this point. But how much had she figured out?

Sam gestured helplessly. "I don't know how to say this. I'm just so tired I can't think. God knows how Phil's doing it. We've been working on this around the clock for five days now —and Phil is carrying nearly all the load. All I can do is hand him the tools and hold things and run a few computer checks. He's the expert here. All this falls on him. But even so, I've gotten so deep inside this thing, so involved with it, I don't even know if I can explain it anymore. But let me try."

Sam took a sip of her coffee and winced. "Ugh. Too strong," she said. She rubbed her eyes and folded her hands on the table in front of her. She looked Suzanne-Remote straight in the eye. "OK. Here it is. There *is* a mind in there, yes. But we don't know *whose* mind. We're calling it David H.C. —H.C. for Herbert Clancy—but that's just a label. *We don't know who David H.C. will turn out to be.* We don't know how strong his mind will be. After all, that mind has been through a lot. It was pulled from its natural body, and then trapped inside an alien form for three months."

Sam bit her lip and then launched into the worst part. "We don't know if the mind currently inside Herbert is even *sane*. Actually, after the literature checks on sensory deprivation I ran a few days ago, we're fairly certain David *isn't* sane right now, not by our standards."

Suzanne's head jerked back. "What are you saying?" she demanded. "That my husband, my client, is insane? Why have you waited this long to tell me?"

"Would *you* be sane?" Sam asked, a bit snappishly, her meager store of remaining patience suddenly gone. "After all those months trapped inside an alien body, unable to speak or act? With all due respect, Suzanne, *you're* a little squirrely after a few months of much less severe sensory deprivation. Think how tough *that* has been. Imagine being *forced* to ride Suzanne-Remote, with no way to shut the robot body down, no way to control its ac-

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tions—hell, no way to close your *eyes*. How long could you handle *that?*"

Sam waited, giving Suzanne a chance to answer, but the lawyer sat there, her face expressionless, and said nothing. At last Sam spoke again, in a far more gentle tone. "I'm sorry," she said. "That was unfair. It's just that I'm so bloody *tired*. Anyway. We can't assume David is sane *now*, but we think that he will *become* sane once the connection to Clancy's body is complete. It will be like pulling him out of a fugue state, literally plugging him back into the real world. We hope and believe that hooking Clancy's body into the system will pull David H.C. back, reground him in reality. And then he'll be OK."

Sam took another sip of coffee, and decided there was one other thing Suzanne had to know. "The trouble is, getting him back might take a while. He's been lost a long time. It might take a while to get back up to speed. We had hoped to awaken him Friday or Saturday, and work on cognitive reintegration, or whatever the hell Phil called it, over the weekend. The trouble is, we lost a lot of time just making this hookup work. Everything else went out the window. But if I understand your strategy properly, even if he isn't quite *all* the way back at one P.M. this afternoon, that doesn't really matter, right?" she asked. "You just need him to be able to answer a few simple questions, demonstrate that his reasoning ability exceeds that of a robot. Right?"

Suzanne nodded stiffly. "That's right. I just want him on the stand for a few minutes. I don't want to risk anything more than that."

"And even if he acts like a crazy person, instead of a crazy robot, that should be enough at least to hold us for the moment," Sam said, completely unaware of how callous her words were.

Suzanne blinked, seemed to be struggling to keep herself calm. "Yes, I suppose. With any luck, that would at least convince the judge that we deserve a bit more time to work with him some more."

"Good. Phil is 99 percent certain he can give you that much," Sam said, knowing it was wildly optimistic to promise any such thing.

She took another sip of her coffee. "Maybe—*maybe* we can even do better. But no matter what, David H.C. is bound to be disoriented at first. He will be seeing the world through new eyes, speaking through a new voice. There will be lots of stressful and complicated information for him to deal with all at once. He might not even understand that he is dead. Some of his memories might be confused, or suppressed, or lost. His situation will be—delicate. If David H.C. is confronted with you . . . "

Suzanne shook her head, clearly confused.

Sam stopped and started over. "OK, to be blunt, if he has forgotten the period since the accident you were both in—and if he is confronted with the confusing and disturbing sight of a robot speaking with the voice of his wife . . . Well, if he sees that while he is still disoriented—it could be very damaging to him. Perhaps throw him back into fugue." Sam looked straight at Suzanne, but inwardly she was cursing herself, hating that she was forced to say such a cruel thing to a woman who had been through so much. *We don't*

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want you around. We're afraid the mere sight of you could drive your husband insane.

Suzanne seemed about to protest, but then she sat up straighter in her chair, and folded her hands stiffly, clearly determined not to reveal her emotions. At last she nodded. "Very well," she said. "I suppose all you can do is your best, and I don't want to interfere with that." She shook her head worriedly, and Sam imagined her switching from *wife* to *lawyer*. "I must admit this doesn't make my job any easier. What you're telling me is that the first chance I'll have to talk to my client is when he's on the stand."

"Right now the alternative is not having him talk at all," Sam said. "That's not much comfort, but it's the best I can offer right now."

Suzanne nodded stiffly. "I'll call here the moment I'm out of court for the morning." And with that, she stood up, stepped out of the kitchen and back into the main room. Phil looked up from his work and caught her eye. "I understand now. I know how hard you've tried, you and Sam," Suzanne said. "I just want you to know that, whatever happens, I appreciate that. Thank you," she said to Phil offering him a thin, forced, smile. He nodded to her, and she let Sam escort her out.

Phil heard the door shut and waited for Samantha to come back in. "Do you think she bought it?" he asked. "Did you satisfy her?"

"I think so. I explained the problem, why she shouldn't be here, and what the situation is, what David might be like when we switch him on."

Phil scratched his unshaved whiskers and grunted. "Of course, there's another problem, Sam," he said, staring at Herbert's motionless body. "I couldn't admit it in front of Suzanne, but I'm still not entirely sure this whole *insane lash-up is going to work.*"

Sam looked up at him with worried eyes and gave him a kiss on the cheek. "Don't think that way, Phil, or we're all going to be in big trouble. Gotta run. I'll see you at the courthouse."

Phillipe Montoya Sanders watched Samantha leave, and then turned back to David Herbert-Clancy.

"Well," he said to the one or the two or the three of them, "it looks like it's just you and me."

CHAPTER FIFTEEN

Answer As A Man

Gunther Nelson stood by his desk, reading the words on the pages one last time: Without looking at his desk, he picked up a very old-fashioned clipboard and pulled a markup pencil from his pocket. He clipped the pages to the board and started working through the copy, marking it up, cutting it, tightening it.

Sam, sitting in the visitor's chair, breathed a sigh of relief. Gunther would not bother doing a markup on copy he didn't plan to use. "Wordy stuff here, Sam," he said. "Editorials have to be short, tight, right to the point. You can't write them top-down like a news story."

"Then you're going to run it," Sam said.

Gunther finished with the copy and tossed the clipboard back on his desk, where it landed with a clatter. "I can take your name off it and sign my name

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to it," he said. "Then I can submit to the editorial page crowd, and they'll know you wrote it, but they'll have to pretend *I* wrote it. They'll monkey with it for a while, and then, if they decide to OK it, they'll take my name off and sign *their* names to it, and get the executive editor to sign off. Then he fools around with it if he feels like it, and takes *everyone's* names off, and runs it. From then on we pretend *no* one wrote it. And by that time that will almost be true. Probably every single word will have been changed. It might not say anything remotely like what you've written. That's the way editorials work around here."

"I know that, Gunther."

"And even if they run it, it's not going to change the world. No one's going to charge off and write new laws just because we say so. And even if they do, by the time the smoke clears the law might not say anything like what you say in this piece here."

"I know that, too, Gunther. But it really doesn't matter. I almost don't care what the editorial says, or what the laws end up being."

"Then why come in here begging me to get behind you on this when I should be firing you for dropping out on a story?" Gunther asked.

"Because all I want is for people to start talking about it," Sam said, her voice unusually soft and low. "I want people to think about rights for replica humans. The sooner they do that, the sooner a consensus will form on it."

"Suppose the consensus doesn't happen to agree with you?" Gunther asked gently, sitting down on the edge of his desk.

"I think it will," Samantha said. "I think people are pretty decent, when you get right down to it. They'll see that it's right for people to try and stay alive. They'll find some sort of way for that to happen."

"I wonder if it is right," Gunther said, almost to himself.

"What do you mean?" Sam asked.

"I mean I wonder—is it right to build a man out of Tinkertoys? A body from here, a mind from there, a memory from somewhere else? Plug him together and take him apart? What's next? Mix and match parts? A modular man? If you take him apart again, copy his mind into another brain, which part is the human? How far down that road can we go with that sort of thing before the idea of a human being loses all its meaning?"

"I don't know, Gunther," Sam said. "I don't know if it's right, either. But we live in a world where it's possible, and that means we'd better face it." She stood up and gathered her belongings. "And maybe," she said, "it's not a question of what 'human being' means, but what it means to be a human being."

She looked at him, her face drawn and serious. Then something of her native spirit came to the surface again. She smiled and laughed. "God, I sound pompous when I'm tired. I'm going to court."

Phillipe Sanders checked the power circuits for the eighth time. He did not intend to make the same mistake twice. It was embarrassing to be tripped up by such a stupid error. Lurking at the back of his mind was a far more serious concern—what other mistakes had he

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made?

He stood and stared at Clancy; the robot's naked plastic body now closed up, all the access ports sealed. Clancy sat there like a mannequin waiting for the clothes to be hung on it. Was it going to work?

Phil rubbed his jaw worriedly. A backwards power converter was no big deal, but what other parts were in the wrong way? What other bugs were there in the communications routines he had written?

One way to find out, he thought. He reached out again, switched on Clancy, and then Herbert.

Again the faint twitches as power fed into the circuits—but smooth and quiet this time, no fuss, no loud noises.

Power reaches me, and this time it is not cut off. Without any warning, I am caught up in a mushrooming wilderness of sight and sound, a tangle of sensory inputs that I can make no sense of. The weird abstractions chase each other, but then, by some process I cannot understand, they resolve themselves into coherent images. I can see and hear.

But then it hits me. I do not see through my own eyes. Instead I see myself, my body, Herbert's *body lying on a test stand or workbench of some kind, and somehow all the lights and colors seem overbright. Here and there tangles of incoherency, of strange abstract spasms of light, drift through my vision. At last I realize that I am, at least in part, hallucinating. And yet much of what I see has the indelible stamp of reality. Not completely, not altogether, but I can distinguish reality from fantasy.*

Where am I? Is this the place they brought me to last week? I want to look around, and an old reflex, unused since my death, causes me to turn my head hard to one side and see where I am. The images I see are a large room, yes, the one to which I was taken. And I see a man, a tired-looking man, a look of utter delight on his face.

Turn my head? *Suddenly I forget my curiosity about the room and realize what I have done. I sit there, wherever, whoever, I am, completely stunned. It is the first voluntary motion I have made since I activated the mindloader. I look down—and see a body. A human—no, a humanoid body, with flesh-colored plastic skin. Are these my arms? Experimentally, I try to move my left arm a little—and it flaps out to its maximum extension, almost striking the man before he jumps out of the way.*

He speaks, and his voice booms in my ears, so loud I cannot understand him. Suddenly I—feel? sense? hear?—a message from somewhere in the diagnostics of my new body.

SELF-CORRECTION ROUTINE ON —REDUCE OVERALL SENSORY POWER INPUT THIRTY DECIBELS. COMPLETE. SELF-CORRECTION ROUTINE OFF.

The overwhelming brightness of the room dims. I try to move my arm back and it moves slowly, smoothly. Suddenly the man's voice is clear, coherent. But even so, I cannot yet make out the words he is saying. I concentrate, focusing my attention, learning to hear through new ears.

"Id erkd. Id erkd. Ur ontrollng Clanky!"

SELF-CORRECTION ROUTINE

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ON—SIGNAL PROCESSOR REFINEMENT SYSTEM—AUDIO. PHASE MODULATION OPTIMIZATION SEEK. COMPLETE. SELF-CORRECTION ROUTINE OFF.

I do not know if I willed the correction, or if this body did it by itself, or if it responded to my reflexive attempt to hear better, but it does not matter. The words become clear.

"It worked. It worked! You're controlling Clancy!"

Clancy? Is that who I am now? I look down again, see my two legs. I see a cable, a thick cable, draped over my left shoulder. I turn my head and see it move. I trace it back the other way, across the floor, and into Herbert's body. I begin to understand.

"Let's try standing," the man says. He steps toward me. I reach out my arms and rest them on his shoulder. He grunts with the effort of helping me to my feet.

BALANCE SENSOR SHIFT TO UPRIGHT MODE.

But this time I barely notice the mechanical, reflexive voice inside me. Already it is fading into the background. The man steps back, and I let go my hold on him.

I am standing, on two feet, controlling my own body. I will my eyes to shut and they do. I will them open and see again. What a luxury that is for me, after so many months when I had no choice whether I could see or not.

I try to speak, to say what a wonder it is, but instead I make a noise like a foghorn fighting with a chicken—a cacophony of loud boomings and squawking. The man slaps his hands over his ears. I wait for the inner voice to speak, and tell me it has corrected the problem, but it does not come. And then I understand. Speech is voluntary, under delicate conscious control. I try again. The sound is different, less harsh and terrible, but it is not speech.

"Are you trying to talk?" the man asks.

I nod my head, vaguely embarrassed to have failed at any more sophisticated communication.

"OK, we'll work on that. But there isn't much time." The man glances at his watch, and then runs his fingers through his hair, upset and alarmed. "Sweet Jesus, there isn't much time at all. We have to get some clothes on you, on top of everything else. Why didn't we think of that? We can't use your old delivery-boy outfit. Maybe there's something of mine that would fit you.

I am lost, disoriented. I sense that I have forgotten most of what I knew when I was powered down.

What is going on?

Courts of law, Suzanne reflected, are not what they are cracked up to be. The myth was that they were centers of quiet reflection, the places where problems were carefully adjudicated, the rights and wrongs balanced and judged with sober reflection. But whenever some chaotic case burst into the place, bubbling over with odd personalities and strange circumstances, someone would inevitably declaim that the place had turned into a circus.

That, Suzanne reflected, as she stood at the entrance to Judge Koenig's court, was a misconception—a circus atmosphere was a courtroom's natural state. It was the quiet, the sobriety, that were

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unnatural and rare.

How could it be otherwise, when you considered the sort of people who came into court? Thieves, charlatans, con men, hookers, liars and frauds, the unjustly accused and the villains posing as such, the aggrieved and hysterical victims, the angry litigants suing each other more out of a need for revenge than a desire for justice. All of them represented by a class of citizenry—trial lawyers—known for their love of theatrics, their aggressive natures, and the size of their egos.

More often than not the issue at hand was something outside the normal course of events, something so strange, so baffling, so horrifying, so harmful or violent or passion-stimulating that it could not be dealt with in the everyday life of society.

But even with that in mind, things were definitely a bit more out of hand today. The same crowd of cyborgs was here, adding more than their share to the noise—and, no doubt, to the aroma—in the courtroom. She could tell that much by the wrinkled-up noses of some of the court regulars, even if her remote was not equipped with a sense of smell. The reporters were there as well, brought out in double force by rumors of high drama in the offing. And the thrill-seekers were here too, courtroom aficionados, the ever-present oddities from the fringes of society who regarded trials as their prime source of entertainment. They tracked the judges and lawyers the way racetrack touts handicapped the ponies.

Everyone was here today.

Suzanne moved into the courtroom and made her way to the defense table. Judge Koenig was already at his bench, conferring with his clerk. He looked up when Suzanne arrived.

"Madame Jantille. I don't see your client with you."

Damn. That hadn't taken long. "No, Your Honor," she said as she arrived at the defense table and set down her attache case. She saw Ted Peng sitting at the prosecution table. He looked at her as she spoke, an odd sort of expression on his face.

Suzanne cleared her throat and spoke. "I was informed that this morning's session was to be given over to a prosecution motion. As I understand the current procedural rules, defendants are not required to attend pre-trial motion sessions. He will be in court this afternoon."

"Hmmph. Suppose I ruled that he was required to attend this particular session?"

Suzanne took a deep breath. There wasn't much for it but to tell the truth—or at least some of it. "My client is somewhat indisposed. I'm afraid I don't know the technical terms to explain his difficulty clearly, but I am assured that he will here, in court, ready for you, at one P.M."

"I see," the judge said, obviously annoyed. "Madame Jantille, you have had almost a week's warning that this case was going to go forward this morning, and I have received no prior notice of a difficulty with your client. I don't like surprises or vanishing defendants. Do you have any reason that I shouldn't hold you in contempt?"

"Excuse me, Your Honor," Peng said, rising to his feet. "In light of the motion I am about to present, I don't

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know that a contempt citation would be, well—appropriate."

"Are you presuming to tell me my job, Mr. Peng?"

"No sir, but I believe you might not feel the need for the citation after our motion is presented. I might add that the prosecution has no objection to the defendant's absence at this time. It might well turn out to be for the best."

"Indeed. Very well, Mr. Peng. You intrigue me. I will allow you to guide me in this for the moment. But bear in mind, Madame Jantille, if I do not agree with Mr. Peng, contempt still remains a possibility."

"I understand, Your Honor. Thank you."

"Very well, then. If the clerk would formally call the case, we can proceed."

Suzanne sat down at her desk as the clerk spoke the unheard words of legal ritual, more than a bit unnerved. Judge Koenig banged his gavel and called the court to order. "Very well, Mr. Peng. May we now know the nature of this motion?"

"Yes, Your Honor." Peng rose from his seat, carrying three copies of the motion. He delivered one to the bench, then came toward Suzanne at the defense table. He handed her the papers, and leaned in toward her.

There was something strange in his face—guilt, anger, perhaps even a flicker of shame. "I'm sorry," he said in a low voice. "This is not my choice. I do not like this motion, and I wish it could be otherwise. But I have been ordered to do this thing, and I must do it."

Suzanne drew her head back in surprise, a cold feeling in her stomach. "Follow your orders, then," she said.

"Mr. Peng?" the judge said. "Are you ready to proceed? Do we have to wade through the written legalese, or can you tell me what this is about orally?"

"Certainly, Your Honor." He drew himself up to his full height and stood in the center of the court, facing the judge. "Very simply, the United States attorney's office asks that the defendant be provided with competent counsel willing and able to appear in court."

There was a moment's baffled silence in the court, but Suzanne did not hear it. The shock gripped at her heart, and squeezed it. Harsh pain, physical pain, that would not be denied. For a moment, half a moment, the courtroom faded out of her awareness, and she was back in her room at home, a frail, sick cripple of a woman surrounded by machines, her view of the world blocked by the huge mask around her head. Somewhere in her bedroom she could hear an alert monitor going off. But then the pain subsided, and the courtroom reformed around her. She was back in her remote, her robot fists clenched in shock.

"I'm afraid I don't understand, Mr. Peng," the judge was saying. "Madame Jantille is certainly competent, and she is certainly here."

"No she is not, Your Honor, and that is the whole point. It is an excellent simulation, so good that we forget the reality of the situation." He gestured open-handed toward Suzanne, obviously being careful to avoid anything like an accusatory pointing finger. "That is *not* Suzanne Jantille, but a ma-

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chine, a robot operated by remote control. She is no more here than if she was talking to us over a video link, or an audio telephone link."

A muttered ripple of shock passed over the audience, and the judge stared at Peng in open-mouthed surprise.

Suzanne blinked hard, and struggled to collect herself. She stood up and turned toward the judge. "Your Honor, surely the prosecution is aware of my condition—"

"Which is immaterial, Your Honor," Peng cut in. "Madame Jantille's unfortunate disabilities do not outweigh her client's right to competent counsel. Nor do they outweigh the prosecution's right to a level playing field."

"What do you mean by *that?*" Koenig said. "It seems to me that you have all your arms and legs and are capable of many things of which Suzanne Jantille is not. Surely the advantages are all with you."

"No, sir. Not in a court of law. I am here, limited by my own memory and my own preparation, unable to receive real-time assistance either from a computer link or from a committee of experts tucked away in a back room. Suzanne Jantille is *not* here, and can, if she so chooses, have any number of such resources at her beck and call. Indeed, we have no real way of knowing that it *is* Suzanne Jantille operating that remote unit. She could cut herself out of the loop and hook another person into the remote link."

"Your Honor, I must object," Suzanne cried out. "Opposing counsel is questioning my integrity in the most scurrilous manner. He has no basis for such groundless accusations."

"Your Honor," Peng said, "that is most certainly true—if indeed it is Suzanne Jantille operating this remote. We cannot know that it is. Furthermore, Your Honor, granting her the right to represent this case by remote control would create a most dangerous precedent. How long would it be before lawyers with *no* disabilities, or even merely slight ones, claimed the right to use a remote, or a more conventional video link? How long before less scrupulous lawyers took advantage of the chance for realtime links to legal databases, or played switch-hitter tricks with a remote, bringing in substitutes to handle certain points in their cases? The potential for abuse of such technology is all but limitless."

"Your Honor, I renew and extend my objection," Suzanne said. "This motion in and of itself is an obvious piece of trickery on the part of the US attorney's office, a tacit admission that they no longer believe they can bring this case to the conclusion they desire. They want to bring in a more malleable defense lawyer and cut their losses. This motion is not brought to prevent me from committing fraud, or to protect the legal system from a bad precedent. It is brought for one reason, and one reason only—to force me off the case."

Theodore Peng's face was utterly unreadable. "Though I might choose to contest Madame Jantille-Remote's accusation," he said, "the reason for the motion does not matter, Your Honor. It is justifiable on its own merits. A moment ago Madame Jantille-Remote cited the rules governing courtroom procedures. As noted in the written motion, those same rules state flatly, in

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black and white, that all parties to a case must themselves be present or be represented by counsel present in court. There are no exceptions to that regulation, nor should there be."

Suzanne stared at Peng in amazement as he sat down and tried to compose himself, needlessly straightening the papers on his table. Blindsided. Utterly blindsided. She had never seen it coming, and now Peng had given it to her right between the eyes. But Suzanne was not going to go down without a fight. "Your Honor, I must ask that you respond to my objections."

"They are overruled," the judge said, his voice and face both studies in bewilderment. "Mr. Peng's motion has an obvious factual basis. There is no denying that you are not here. Do you have any counterarguments to offer?"

Suzanne opened her mouth and then closed it. She couldn't think of anything. Maybe if she had more time, maybe if she didn't feel so desperately ill, maybe if she was not so utterly confused by her circumstances, it would have been different. But she was drawing a blank. "Not at this time, your honor."

"I was very much afraid of that. The court will take a recess, and arrange with Madame Jantille to assign and brief a replacement counsel."

No! Something in Suzanne could not bear that idea. To surrender her case, *her case*, to some stranger, some wet-behind-the-ears kid, or some cheap shyster willing to take on a dead ugly case strictly for the money. She could not accept it. An idea popped into her head, an alternative. In a split second, the solution lay open before her.

But could she accept the alternative? It was a way to get past this obstacle, and maybe a way to go all the way, turn the tables. But was she up to it? Could she bear the humiliation? Did she even have the physical strength to *survive* it?

Maybe. Maybe not. But the hell with that too. She could not give this one up. "Just a moment, Your Honor. The prosecution has already stipulated my competence." She turned toward Peng. "Can I then understand that the only problem is with my not being physically present?"

"Ah, well, yes."

"Then, Your Honor, if I may request a recess to make the needed arrangements, this mountain will come to Mohammed." Steeling herself, launching the words with as steady a voice as she could, she spoke. "I will be here, in the flesh—or what's left of it—in time for the afternoon session."

There was a noise from the prosecution table, and Suzanne looked over at it. Peng was half out of his seat, ready to object, when it seemed to occur to him that he had nothing to say. It was his turn to look surprised, Suzanne thought.

Judge Koenig looked at her, rubbing his jaw. "Very well," he said. "That certainly would answer Mr. Peng's objection. But that will be an end to this. I'm telling both of you that. There will be no more of this skirmishing—at one P.M. we concentrate on the substantive issues of this case, and nothing else. No more theatrics. Is that understood?"

"Yes, Your Honor," the two lawyers said in unison. But Suzanne could not help but smile to herself. David would be here this afternoon—and his

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entrance, revealing his changed appearance, would be nothing if not theatric.

"Very well," the judge said. "Then this court is in recess until then." He slammed down the gavel and stood up.

Suzanne watched him go out, and then began to gather her belongings. She would have to rush home, call the technical nurse service, arrange transport, arrange a powerchair or powerbed here at the courtroom—a dozen things. But wait a moment—she *was* home. That damned Peng was right. She wasn't *here*. There was no need to bother with the ride home at all. And if they were going to accuse her of taking advantage of a remote, then she might as well do it.

She closed and locked her attaché case, sat down, folded her hands, and shut herself off.

Theodore Peng watched the gavel come down, furious with himself for what he had done, angry with the judge for going along, and, somehow, angry at Suzanne as well for outsmarting them all. But no. That was wrong. It was Entwhistle that deserved his anger. Entwhistle and Ted Peng had done this, no one else. Accept that. If it left a bad taste in his mouth, there was no one else he could blame.

The courtroom spectators were making their way out, a noisy, busy group that seemed to make him feel more alone than he would have in a room full of silence. He watched them filing out, the cyborgs and the fringies and the everyday people. *All of those people are against me*, he realized. *They all want me to lose. And maybe I want it too.* He did? *That* was a strange thought for an assistant US attorney to have. It suddenly dawned on him that he wanted out. He had grown weary of this fight. This situation had gotten completely out of control.

He turned toward the defense table, feeling lost, feeling that he should say something.

He stepped toward Suzanne, but she sat there, motionless, staring straight ahead. "Madame Jantille?" he asked, but there was no response. Suddenly, impulsively, he put his hand on her shoulder, but she did not react. He shook her. Still nothing.

At last he understood what had happened, and drew back from the metal and plastic thing that been a person up until a few moments ago. She had gone home, escaped. Her spirit had withdrawn.

Theodore Peng felt a fresh upwelling of guilt on his soul. It was irrational, he knew that. But, standing there next to the body, Ted Peng felt something more than the thought that a machine had been switched off.

He felt as if Suzanne Jantille were dead, and he had killed her.

I am on trial for my own murder. My wife is defending me. There is a plot of some sort to keep her from appearing, just now reported on the radio, but she will be there anyway. There is a woman named Sam, and the man's name is Phil. They are trying to save me, somehow.

The man, Phil, has told me a great deal that I don't really grasp. I struggle to hold the knowledge in, to know what is going on, but I am not here yet. I am not grounded in this reality. Seeing

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through my new eyes, through Clancy's eyes, my mind still confused and unfocused, landing in the middle of such complex urgency I am in a strange and brave new world, that has such people in it. I recognize the quote, but cannot recall where it came from, or how it got into my mind, or how accurate it is. But strange people, strange creatures there are, and I am one of the strangest.

I ride in Phil's van, and the streets hurtle past in a blur of motion. All is new and untested for me, and my grasp of reality is weak. What if I am mistaking reality for illusion, or warping reality into a false shape, and none of this is truly happening? What if this Phil is practicing some elaborate deception upon me? What if there are events swirling about me, but I am misinterpreting them? What if this Phil is lying to me for some unknown reason?

A swirl of strange color flashes past my eyes again, the world distorts, collapses into geometric shapes and then reassembles itself. Clearly my senses are not yet fully functional. How can I trust them?

If these things are real, if I am interpreting events properly, then I am in a van hurtling down the road.

But perhaps nothing is, but what is not.

I have no way of knowing.

"I can't do it," the tech nurse said, gesturing helplessly with his burly arms. "I can't. By rights you shouldn't even be running a remote. You're too sick. You're malnourished, dehydrated, in a state of nervous exhaustion. You're running a fever. If you don't get complete rest for at least—"

Suzanne gasped in pain and looked up from her powerbed. "It is now 10:30 in the morning," she said in a raspy voice. In a strange way, it felt good not to disguise her sore throat anymore. If it were just a sore throat by this time. "I am going to be, I *must* be, in court, no later than one P.M. You are going to help me get there, and make arrangements at that end for a powerchair. If you help me, I will do whatever you want between now and then. I will eat, I will drink, I will rest."

"But—" the nurse began to protest, but Suzanne rolled right over him.

"If you do *not* help me, I will call another nursing outfit, and then another, and then another, until I find one that *will* help me. If all else fails, I will call a cab, and get to court that way. Or I will call the judge, inform him that I am being prevented from appearing. Perhaps he will issue you a court order requiring you to deliver me. Perhaps he will send a bailiff to collect me. I don't care how it happens, but *I am going to court*. If I have to do it the hard way, I will not have time to rest, or eat, and I will be in worse shape than I am now."

The tech nurse looked most unhappy, but did not speak. She had him weakening, Suzanne thought. All he needed was one more little push. "I'll cooperate with you now," she said in as gentle a voice as she could manage, "if you help me later. Do we have a deal?"

There was another moment's silence, but at last the man spoke. "A powerbed," he said at last. "You're too far gone to handle a chair."

"Fine, fine," she said, slumping back into her bed, suddenly limp with relief. "You've got yourself a deal."

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What a tiny victory, she thought. But perhaps tiny victories were all that were left to her.

"All right then," the nurse said. "But I'm getting you something to eat right now, or else I'm not helping you go anywhere."

Sam Crandall pulled her paycard out of the slot on the autocab and jumped out into chaos. The plaza in front of the courthouse was a madhouse, blanketed with news reporters, protesters with pickets, spectators, knots of people listening to impromptu speeches and debates, speakers and preachers trying to whip up audiences, proclaiming this or that radical position. All of them mixed in with the usual lunchtime crowds of office workers having a bite to eat outside. The hot dog vendors and ice cream sellers were doing a booming business, and there seemed to be a group of cyborgs in red T-shirts, circulating some sort of petition.

She had never seen the plaza this tumultuous. How had it all gotten this out of control so fast? It didn't matter. She checked the time again and swore. She wasn't late, but she was cutting it close. Phil was supposed to meet her here. Where was he? She shouldered her way through the crowd into the building, flashing her press pass to get past security. Security. They'd know if Phil was here. Was there anyone she knew? There, Smitty. He'd help her out.

She hurried through the surging crowd in the lobby and buttonholed the elderly guard leaning on the side of his booth. "Hey, Smitty, how you doing?"

"Hey Sam, you here for the show like everyone else?"

"Sort of, Smitty. But I'm not covering the case. I'm supposed to be meeting a friend, a cop named Phil Sanders. He's doing some work off-duty, transporting some gear for the defense. He probably had to check in—"

"OK, lemme check." Smitty leaned close over his computer terminal and muttered at it for a minute. "Yeah, he's here," Smitty said. "Just came in the side entrance. Parked in the underground lot."

"Damn it, of course that's where he'd go. My brain's not working this morning. Thanks, Smitty." She turned and hurried toward the stairwell. Things were happening too fast. There was no way to get a handle on things.

Down the stairs, into the garage. There, in the utility parking. A big blue van. She jogged over. "Phil!" she called out. Phil was just getting out of the side door and looked up at her, a grim expression on his face. Somehow he had found the time to shave and change into a suit, Sam noted. But the look on his face. She slowed down about fifteen feet from him, wondering what had gone wrong now.

"Is he—is he going to . . . " Her voice trailed off, and she was no longer sure what she was trying to ask.

"I don't know," Phil said. "I've done my best, and I think he understands. But God only knows what will happen in court."

"Did you hear about Suzanne?" Sam asked. "She's coming into court in person."

Phil nodded stiffly. "I don't like it. She's not well, that much I know. It can't be a good idea for her."

"What about—"

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"He's in the van. Here, step back a minute. Don't try talking with him," Phil cautioned. "He's still not really oriented. I think I've explained things well enough, but it would be very easy to confuse him." Phil pushed the door control panel, and the van's rear cargo door slid open. A walk-down slide came out of the base of the van, forming a smooth ramp between the van and the garage floor.

"Come on, David," Phil said. There was a stirring in the van, and then Clancy's rough-hewn face poked out of the van and looked around. He stepped carefully out onto the ramp and cautiously made his way down, the linkup cable trailing from the back of his neck. He stepped to one side of the ramp and looked directly at Sam. She returned his gaze and drew her breath in. *Good God*, she thought. *It worked.* Clancy broke eye contact and started his head swiveling around in a disturbingly mechanical manner. He was dressed in a grey suit that did not fit very well, the tie inexpertly tied. No doubt Phil had dressed him, and had trouble managing a tie around someone else's neck. His sandy hair and blocky features seemed out of place without a Clancy uniform to set them off.

But no, this was not Clancy any more.

This was someone new.

Then there was a low humming noise from inside the van, and Herbert wheeled his way down the ramp, his manipulator arms being careful to keep the cable free of the ground.

The two of them, Herbert and Clancy, stood there at the back of the van, waiting.

Phil shook his head. "Madness," he said. "Absolute madness. How did I get myself into this?" he asked. "Come on, David, Sam. Let's get in there."

Sam resisted the effort to speak as the four—or was it three, or five?—of them walked and rolled toward the elevator. They all got in, Sam pressed the button, and they rode upward. What good was it not to speak, Sam wondered, when the hallway outside the courtroom was bound to be a mass of primordial human chaos?

The doors slid open, and sure enough, it was as bad or worse than the madness out in the plaza. Every kind of curiosity seeker and courtroom hanger-on was there, jammed in with a boisterous crowd of reporters and cyborgs of all kinds. They had to walk through that sideshow crowd, deliver the main freak to the freak show. Sam felt Phil's hand slip into her own and give it a quick squeeze before they stepped out into the corridor.

A wave of silence seemed to wash over the hallway as they made their way down toward the courtroom. David H.C., the linked bodies of Clancy and Herbert, was something that had never been seen before. A buzzing of speculation seemed to build up behind them. Sam felt her heart pounding as the corridor full of eyes pressed down upon her.

She found herself looking at one person at a time, one person only, struggling to keep her mind from the fact that they were *all* staring at her. Look at one, just one at a time. A grizzled, unshaven cyborg in stained coveralls, with two glistening metal arms sprouting from his shoulders, a toothpick dangling from his mouth. A nervous look-

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ing young woman in a conservative business suit, her arms full of papers, staring pop-eyed at them as they passed. A reporter she knew, who managed to catch her eye. He seemed just about to step forward and ask what was going on, but Sam shook her head, warning him off. A tall, burly, bushy-eyebrowed man in some sort of blue medical-service uniform, muscular and solid, but with a firm gentleness in his eyes, carrying some large white-wrapped bundle in his arms. A court security guard, holding the door open for them, trying to maintain his composure—

"Sam! Phillipe!" Suzanne's voice. Funny. Sam hadn't noticed her in the crowd. Sam stopped, turned, and looked in the direction the voice was coming from. From the blue-uniformed man. From the bundle the man was carrying. Now that she looked, she noticed a tuft of hair, an eye, peeking out from the bundle, a burden that now seemed far too small for what it had to be.

Sam felt the blood in her veins turn to ice.

The nurse pulled the blanket back a bit, exposing Suzanne's face. "I'm sorry to carry her in here like this," he said. "But things got confused. They delivered the powerbed to the courtroom before I got here. There was no other way to bring her up."

But Sam was not listening. She stared, fascinated, horrified, amazed, at the face, the limbless body, wrapped in the blankets.

Suzanne. Suzanne Jantille. Sam stepped forward slowly, staring down at the frail, tiny form. Suzanne Jantille. For the first time in her life, Samantha Crandall was looking at the actual person, not at the remote. "Hello, Suzanne," she said. "How—how are you?"

Her face was gaunt, her skin almost transparently pale, her big brown eyes bright and luminous, set against a face almost skeletal in its thinness. "I've been better," she said, her voice little more than a whisper. Suddenly she was caught in a fit of coughing.

Sam glanced toward Phillipe for a minute, and was stunned to see that he was not approaching Suzanne, that instead he was ushering Clancy and Herbert into court.

With a flash of insight, Sam understood, and was terrified at the news that understanding brought. This was the state his father had reached before the end. This was what Phillipe Sander's father had looked liked before—Sam forced back the tears that were suddenly in her eyes and let the thought finish. Before he died. And Phillipe could not bear to look on it again.

"You've got David here," Suzanne said, her voice raspy and weak. "Is he all right? Did it work?"

Sam swallowed and shook her head, determined to keep her voice even. "I don't know. There hasn't been time to ask. I don't even think Phil knows. You'll have to ask him." Sam reached out a hand and touched Suzanne's feverhot cheek. "Oh, Suzanne. Oh, dear."

"It's all right, Sam," Suzanne said, her voice seeming a bit stronger. "I'm used to it. But we'd better get in. I'm sure Nurse Bishop's arms are getting tired."

Sam nodded numbly and followed the nurse inside the empty courtroom, no longer really seeing much of any-

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thing. She had stumbled up to the first row of the spectators' seats before she realized where she was. She looked around herself, and suddenly burst out in a smile. It had been a mistake, a mad joke, a dream. There was the real Suzanne, sitting at the defense table, strong and whole—

And not moving. Sam looked from the remote to the woman, from the woman to the remote. *I'm looking at* The Picture of Dorian Gray, she thought, *the image of the person split away from the reality, the two finally and utterly divergent from each other.*

The strong, healthy, youthful machine, dressed in its confident business suit, staring straight ahead, motionless, suddenly no more than an inert mannequin, a dress-up doll grown large. A doll that provided the illusion of strength and health for the mutilated, wasted, tiny body of the real Suzanne. Sam watched as Nurse Bishop gently settled Suzanne into the compact portable powerbed, tucked her in, strapped her in, and arranged the controls. He raised the head end of the bed, bringing Suzanne's head up nearly to normal eye level. He set up a control frame that would allow Suzanne to control the bed by moving her head. At last he stepped back and left her alone.

Sam looked at her. A pale white face, framed by unruly, uncombed, grey-flecked chestnut hair, the form of her limbless trunk a too-small bulge under the sheets of the powerbed. An ethereal face, lost in a sea of crisp white linens.

And sitting at the defense table, at the place reserved for the defendant, next to the motionless form of Suzanne-Remote, sat another humanoid robot, Clancy, looking about himself with every indication of intense curiosity. At his feet, kneeling there like some enormous dog at the side of its master, was Herbert. Suzanne-Remote, Herbert, Clancy. In some bizarre way, it was a family portrait, a nightmare image of the happy couple.

Sam sensed Phil standing next to her. She turned toward him, and saw that he had regained his composure, at least somewhat. He looked toward Suzanne, the real one, the flesh and the blood of her, forcing himself to see her, and nodded. "Hello, Suzanne."

"Hello, Phil," she said, and lost herself in a fit of coughing for a moment. At last she stopped and nodded toward the collection of robots at the defense table and grinned. "I may be in trouble. The judge ordered me to avoid any further theatrics."

Theodore Peng arrived at court just as the first of the spectators was let in, just as the judge appeared through his door at the rear of the bench. The clerk called the court to order, and Ted Peng was already in his seat, shuffling his papers, before the image of the woman in the bed truly registered on him. His head snapped up as if a puppet master had pulled a string. *That* was the opposing counsel. Sweet Jesus God. What had he done?

But then the gavel smacked down, and it was too late to wonder such things.

Judge Koenig adjusted the papers on the bench, and then looked down at the scene before him. He sat nearly as motionless as Suzanne-Remote, an expec-

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tant hush blanketing the courtroom. His eyes swept over Suzanne, over her inert other self, across Clancy and Herbert and the link that bound them. At last he closed his eyes and bowed his head for a moment, in prayer, or perhaps merely in an effort to control his own frustration. At last he looked up again.

"Madame Jantille," he began. "I must offer my sincere and heartfelt apologies. It is plainly obvious that it has required great effort and personal courage for you to come here today. The court notes and appreciates your dedication to your client and your case. But I am a judge of the facts and the law as well as a human being—and I am forced to leave such consideration to one side and judge the case on its merits. I must hold lawyers, however courageous, accountable for their actions. So please tell me: Why in God's name are all these robots cluttering up my courtroom? Herbert has to be here, I understand that. But why the other two?"

Suzanne wet her too-dry lips and nodded her head for a moment. It was damned hard to express respect by body posture when you were reduced to a head and a torso. She struggled to take a deep breath, restrained another fit of coughing, and spoke. "I tender my apologies for the continued presence of my remote, your honor," she said, her voice deep and raspy, her breath coming in harsh gasps and wheezes. "In the rush to arrange my arrival here in person, there simply was no time to arrange for her to be collected. I should have put her in homer mode and had her walk to her relay van, let the van take her home. It simply slipped my mind. As to the other human-form robot—that is Clancy, through whom my husband will speak."

Koenig looked almost ready to explode. "Are you suggesting that this robot is some sort of spiritualistic medium? Because if you are—"

"No, Your Honor, certainly not," Suzanne said with a bit too much animation. She had to stop again for a minute, for another fit of coughing. Her nurse came toward her, but she shook her head, stopping him from approaching. "Excuse me, Your Honor. I am not in the best of health. To explain briefly, there was a malfunction during the mind-load experiment that put my husband's—my client's—brain inside Herbert, rendering my client completely unable to speak or to control Herbert's body in any way. As this other robot, Clancy, has a nervous system based on a human model, it was possible to adapt Clancy, make him serve as a substitute body. In short, my husband's mind resides in Herbert's body, but directly controls Clancy. Herbert is programmed to follow Clancy. The last of the adjustments to the system were only made this morning." She let out another gasping breath, worn out by the long speech.

The judge did not seem to notice she was still in discomfort. "More insane techno-gibberish," he said. "Mr. Peng, are you going along with this nonsense?"

Peng rose and spoke. "For the moment, yes, Your Honor. I don't know for sure that the defense has accomplished it, but to the best of my knowledge, such an arrangement is technically possible. I would be most interested to see if the defense has succeeded."

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The judge sighed. "I see," he said at last. "Mr. Peng, I take it you would be willing to let the defense present its arguments first?"

"Under the circumstances, yes, Your Honor."

"Very well. Madame Jantille, you may begin."

Suzanne turned her head a bit, and took a sip of water through the powerbed's drink straw. "Thank you, Your Honor," she gasped. "The defense calls David Bailey, also known as David Herbert Clancy Bailey, to the stand."

All eyes turn toward me, but I am distracted by the sight of the inert robot I sit next to. I know who it is, but then I turn my head and see the same person once again. The two are vastly different in appearance, and yet I know them to be one. The same person, and yet not. Both are my wife, of that I am certain. I feel a strange excitement inside myself. The sight of her convinces me. This is real, no dream, no fog of delusion over true circumstances. I will help Suzanne help me.

If I can.

I stand and walk to the witness box. Herbert stands as well, and follows behind me, the two of us moving slowly and carefully. I get to the box, and sit in the chair, and it creaks under the weight of my robot body. Herbert moves to one side of the box and kneels down, lies at my side like a dog on a leash.

It was hard, Suzanne told herself, wondering how the fever could be this bad and not drench her in sweat. It was terribly, terribly hard. But it was nearly over. Once David was on the stand, the case would be decided, one way or the other. It would be David's words and behavior that would decide if he was human. And that was as it should be, and nothing else mattered. Nothing at all.

The clerk took the bible in her hand and, moving a bit hesitantly, approached the witness box. Keeping her body as far from the witness as possible, she shoved the bible forward.

Clancy's smooth, mechanically perfect arm swung out and down, and placed itself neatly and precisely on the bible.

"Ah, ah. Do you swear to tell the truth, the whole truth, and nothing but the truth, so help you God?" the clerk said, blurting the words out as fast she could.

There was a moment of silence, deep and quiet.

Clancy's head shifted a bit and swung around to face the clerk. Suzanne felt herself holding her breath in spite of herself, knowing that she would have to fight that much harder for air in a minute.

"I do," he said at last, his voice firm and clear.

The court buzzed and hummed as the spectators reacted to the sight of a robot taking the stand, a witness in his own defense.

Tears welled up in Suzanne's eyes and she gasped for breath. But it was not the sight, but the sound, the words, that struck at her heart. They were not just the first words he had spoken in court, but the first words Suzanne had heard him say since his death. *He was alive*. She felt her heart beating like a trip hammer, the pain and strain in her

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body competing with the thrill and triumph in her soul.

The rituals of the oath were over. The clerk took her bible back and retreated as quickly as she could.

With a faint whirring noise, Suzanne's powerbed moved forward, toward the judge's bench and the witness stand.

Gasping and wheezing in pain, Suzanne Jantille raised her head as far as she could and looked straight at the strange conglomeration of spare parts in the witness stand. Pain, fear, loss, and even a flicker of triumph swept across her face. A tear slid down her cheek, and a broken smile of victory lit up her too-pale face.

But the pain and fear didn't matter anymore. She had won. There was no doubt about that, now. With those two words, David had broken through. No robot could have handled the syntax and the rhetorical flourishes of the oath, understood the ritual and dealt with it. Only a human could have done that. He had answered as a man would do, not as a machine might.

She looked at the judge, and saw the same knowledge in his eyes. And if the judge saw that David was alive, how could he possibly permit David to be tried for his own murder? The case, the game, was over even as it began. She shifted her head as best she could to look at Theodore Peng. She could read it there, in his face too. He knew he could not overcome this move.

The prosecution's whole plan had centered on a mute, helpless, inarticulate defendant. But her husband was in the witness stand, able to speak for himself. All else crumbled before that simple fact. She turned back toward Clancy. "Could you state your name for the record, please," she asked, her voice raspy and weak, the blood singing in her temples. There was something wrong with her vision as well, but that didn't matter.

Again there was a long pause as Clancy's—no, David H.C.'s—face turned toward Suzanne. The dead man looked at his wife's face. "My name was David Bailey," he said. "But I am not myself anymore."

"Then, then, who are you?" she asked, forcing the words out, struggling to hold on, knowing her grasp was weakening. But it didn't matter anymore.

"I *am* David Bailey," he said a bit more firmly. "But I have been to some very strange places." David H.C. paused once again and looked at her carefully. "And you are—yes, you are my *wife*. My wife," he said, in a voice of husky emotion no robot could achieve. He stood up in the witness box, leaned forward, raised his hand and reached out for her. "You are—you are Suzanne."

The tears were flowing freely down her cheeks now. "Yes, yes I am," she said, speaking scarcely above a whisper.

She paused a moment and came closer, closer. "Hello, David," she said in a voice so weak and thready even she could barely hear it.

Now his hand, his hard plastic robot hand, could reach out and touch her face, be wetted by the tears she cried.

Somewhere outside the two of them, the courtroom and the judge and the crowd still existed, but Suzanne did not

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see them anymore. The world was a warm and glowing fog, with nothing in it but the face and the hand of a robot, the face and the hand that were now her husband's.

"You've changed," he said, looking at her with a thrilling intensity.

She smiled, and even laughed quietly, and paid for laughter with another wracking cough. "Yes," she said. "And so have you."

He smiled, and she had never seen a finer sight. Then, suddenly a look of terrible sorrow seemed to cloud that plastic face, a face that should have been all but immobile, as if a painful memory had just erupted to the surface. "I'm sorry," he said at last. "It was an accident. The experiment failed. I did not mean to leave you then."

She felt it coming, the wrenching pain, the fog lifting up over her, the lights growing dim, her breath growing short. The pain washed over her, reached out to claim her, but she held it off a moment longer. "It's all right, David. You came back. Who else has ever done *that?* I don't think—*I* can."

She looked again at his perfect face, struggling to hold the collapse off, to let this moment pass and end.

But her tormented body could restrain itself no more. At last it came, the spasm, the stabbing, wracking coughing fit that would not stop, the sudden impossibility of breathing, the horrible wrenching wheeze of lungs struggling to take in the air that would not come.

She was unconscious before the tech nurse could reach her, David's hand still touching her face.

* * *

EPILOGUE

My wife, Suzanne, died that same night. The pieces of paper say respiratory collapse brought on by pneumonia, but that was merely what got her first. Anything could have carried her off, once she started driving herself as hard as she had.

Three days have passed since then.

The fog has largely lifted from my mind in those three days, but it is true, what I said in court. I am not myself anymore. I have been changed, burned and refined, purified and then alloyed anew in a crucible, a furnace, that no man or woman before me has ever experienced. Yet others will follow. I know it.

Yesterday, two days after Suzanne's death, the hearing reconvened, and I represented myself. The judge ruled me human. In the tumult and chaos of that courtroom there was little else he could do.

But his ruling did not even matter in the end. Theodore Peng, honorable warrior, acting contrary to Julia Entwhistle's specific instructions, that day announced in court that the United States attorney's office was dropping all charges against me. He had no more stomach for the fight.

He announced his own resignation on the courthouse steps an hour later, and declared that he would start work immediately campaigning for Sam Crandall's Fresh Start proposal. The papers and news links have been full of the idea.

Now I stand by the graveside, and look down into the place where death lies. She died for me, died in the act of winning my life for me. The service is

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brief, and private, and quickly ends. Only a few friends have attended, the press and the crowds kept well at bay.

The image is burned in my mind, of my poor wife's wasted, weakened frame, lying dead in her powerbed, while her remote unit sat perfect and inert at the defense table. It was the remote that the world saw, that formed the world's image of Suzanne.

Samantha has told me how she thought of Dorian Gray, but Suzanne lived the reverse of Gray's life. It was my wife's image that remained the same, while it was the reality that wasted away unseen—killed not by depravity, but by the search for right.

There are few better deaths.

Farewell, Suzanne, I think. *I shall always miss you, and mourn you, and love you. There is no end to the debt I owe to you.*

The reporter, Samantha Crandall, and the policeman, Phillipe Sanders, walk back to the cars with me, after the graveside service is over. Strange and strange again, they are both here doing their jobs. Sam is covering the funeral for the *Post*, and Phil is serving as traffic control officer for the funeral cortege. He has accepted his demotion with dignity, and I have no doubt that if he chooses to remain on the force, he will rise up in the ranks again, well past his former station. He is not a man who quits, or fails.

It is awkward for me to walk, even yet. I have not yet learned the knack of managing Clancy while relying on Herbert to take care of himself. Clancy's body walks ahead as always, while Herbert's follows loyally behind, the weight of his body driving his feet deep into the soft earth. It is strange that I do not truly know which body is mine, which, if either, I truly inhabit. Both, I suppose, though at times I feel attached to neither.

Phillipe tells me that, given time, he can replace the cable connecting my two bodies, install a radio link, and thus let my Clancy body roam free while Herbert remains at home, bearing my mind, my brain. A remote system, not unlike Suzanne's. I can see the way it could be done, and I am eager to bring my old skills to the job. At times it seems to me that a radio remote system would be a great improvement. Other times it sounds like a most disturbing change. I am growing used to who I am, a soul dividing into two metal vessels. Perhaps I have had enough with changing bodies.

We are at the cars, and I am about to board my remote van for the ride home, when Sam stops me, touches Clancy on the arm, and looks back toward the grave. Her face is full of sadness, and of bewilderment.

"Why?" she asks me. "Why? Why did she put herself through all that? The pain, the humiliation? Why did she struggle so hard? Other quadriplegics have turned down remotes. Some have even chosen to die. *Why did she do it all*? Why did she fight so hard to save you when it was a one in a million shot you were even still alive?"

I look at Samantha Crandall, and see a lovely young woman, her flame-red hair caught by a playful breeze, a strong young man standing by her side, two people clearly at the beginning of things. Behind them I see a green hillside, a blue sky, a white cloud. I hear

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birds singing, the low hum of human conversation, see the little knots of people gathering together here and there, reaching out to touch each other, comfort each other in grief. I hear the sound of laughter, incongruous but welcome in this place, the sign that someone has shared a happy memory of Suzanne, found the joy in her life even amidst the sadness of her death.

I look back to Samantha, and I tell her the reason, the obvious reason, the *only* reason my wife could possibly have had. "People," I say, "who have been through what Suzanne went through, what I went through, who have lost all we have had, find out something the rest of you never truly learn, never truly appreciate to its fullest. It is the people like us, the ones who are just a little bit alive, who work the hardest to *be* alive.

"Let me tell you her reason. She fought like fury, and she died, because she believed something. Believed it, *knew* it, deep inside, with all her heart and soul, believed in that something so deeply that she gave up her own share so others might have it.

"Suzanne," I say, "believed, first and foremost, that it is *good* to be alive."

What other belief could be better to die for? ■

●In general, children, like people, and people, like children, prefer entertainment to education.

Denis Diderot

●It is usual nowadays to ignore what should be done in favor of what pleases us.

Plautus

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The Alternate View

CERN AND THE LHC

John G. Cramer

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For the past six weeks I've been living in Meyrin, Switzerland, a village sandwiched between the great city of Geneva and the French border, in the broad valley between the long Jura and Saléve mountain masses. I have two more weeks of near-monastic life here before I return home to Seattle, rejoin my wife and family, and take up my faculty responsibilities at the University of Washington. I'm here because I'm doing an experiment at CERN, the European high-energy physics laboratory, which is located in Meyrin.

In this column, however, I'm not going to talk about my own work, but about CERN's fast-track plans for building a new and more powerful particle accelerator, the *L*arge *H*adronic *C*ollider or LHC. The LHC is to come into operation around 1999. It is the principal competition for the SSC, the huge US accelerator presently under construction in and around Waxahachie, Texas. (See my AV column "The Coming of the SSC," in the March, 1988 issue of *Analog* for a description of that project.)

The European and American approaches to the construction of high-energy accelerators have always been distinctly different. In the United States it is usual to turn off aging high energy accelerators that can no longer produce forefront physics. The Brookhaven Cosmotron, the Argonne ZGS, the Princeton-Penn Accelerator, Columbia's Nevis Cyclotron, and many smaller machines have been victims of this accelerator evolution-in-action. The Berkeley Bevalac and the LAMPF facility at Los Alamos will probably be the next to join the ranks of extinct accelerators.

It has also become standard in the USA to build any new major accelerator facility at a new place. The five original AEC (now DOE) national laboratories at Argonne, Berkeley, Brookhaven, Los Alamos, and Oak Ridge, remnants of the World War II Manhattan Project, have been systematically bypassed as sites for new large accelerator projects. Instead, major new national laboratories have been created at SLAC near Palo Alto, California, at FermiLab near Chicago, and now the SSC Laboratory at a site near Waxahachie, Texas.

There are political and sociological advantages to the rather expensive US practice of scattering new national laboratories around on the landscape. It's a mechanism for more broadly distributing federal spending, of slicing off huge slabs of federal pork for states and districts where political power is concentrated. The sitings of FermiLab near Chicago and the Johnson Manned Spaceflight Center near Houston, for example, were reportedly the result of a smoke-filled-room deal cut between Senators Lyndon Johnson of Texas and Everett Dirksen of Illinois when they led their parties in the US Senate.

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But there are also other reasons for the American practice. Beginning a new laboratory in a new place is consistent with the frontier spirit of the US. It is a chance to walk away from the entrenched time-serving bureaucracies and over-the-hill scientific and technical leadership of the arthritic older national laboratories; and to start the new enterprise with a clean slate, selectively recruiting energetic new people and developing a new sense of purpose.

There is perhaps wisdom in this approach. The only recent attempt to build a new major high-energy accelerator at an existing national laboratory came to disaster when the magnets designed for Brookhaven's ISABELLE proton-proton collider failed, and the project had to be cancelled. The strategy of starting fresh, on the other hand, has worked very well at SLAC and FermiLab, and it seems to be working now in the construction of the SSC. It does, unfortunately, have the side effect of reducing our nation's best accelerator builders to the status of migratory workers with Ph.Ds.

Europe decided long ago that it could not afford to do high-energy physics in the spendthrift American style. European science springs from a broader sense of history, a waste-not want-not mentality and a long tradition of high technical craftsmanship coupled with job security. Abandoning a large scientific facility, firing its employees, and starting fresh somewhere else is as alien to the European mentality as tearing down a great cathedral so that a more modern one could be erected on the site.

Most old accelerators at CERN are not turned off. Instead, they become the injectors for the new accelerators. The old 24 GeV CERN *p*roton *s*ynchrotron or CPS, which first went into operation in 1959, serves as the injector for the 400 GeV SPS (Super Proton Synchrotron) and first began operation in 1976. The SPS in turn serves as the injector for the *l*arge *e*lectron-*p*ositron (LEP) accelerator which came into operation in 1989.

The CPS is a relatively small machine, located in a ring-shaped tunnel about the size of a circularized football stadium. It injects the SPS ring, which is about 2 kilometers in diameter, too big to fit on the CERN site. This problem was solved by using heavy tunnel-boring equipment, the same kind used in making subway tunnels, to dig a 6.3 km tunnel beneath the French and Swiss countryside. The beam of particles in the SPS must cross two international borders about 48,000 times per second during the acceleration cycle traveling at just under the speed of light.

My CERN experiment (NA35) uses 200 GeV/nucleon sulfur ions from the SPS that come up from underground and are delivered to a large hangar-like building in the North Area, a separate part of CERN located near the village of Prevessin, France. It takes about 15 minutes to drive there from the CERN Hostel where I'm staying, on the other side of an international border.

The 6.3 km SPS tunnel, however, is dwarfed by the larger tunnel that houses the LEP accelerator. The LEP tunnel is 27 kilometers long and was bored even deeper underground. It circles under the French countryside, at its northern edge tunneling under the Jura mountains. LEP is mainly in France, and dips into

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Switzerland only as it approaches the CERN Meyrin site. It accelerates a 90 GeV beam of electrons in one direction and 90 GeV beam of positrons in the other, bringing them into head-on collisions at 8 points around the LEP ring. The small French villages of St. Genis, Enchevey, and Ferney-Voltaire are the sites of above-ground staging areas and deep man-made caverns that house the four major LEP experiments, ALEPH, DELPHI, L-3, and OPAL.

Charged particles give off electromagnetic radiation (light) when they are made to turn a corner. This radiation, called synchrotron radiation, is particularly apparent with electrons because they are the least massive of charged particles. Synchrotron radiation bleeds away the energy of electrons (or positrons) when they are accelerated in a circular path. The smaller the circle, the greater the loss. The circular LEP tunnel was made very large to minimize this problem.

Protons have 1836 times more mass than electrons and produce far less synchrotron radiation when turning a corner. The limiting factor for the acceleration of protons is not radiative energy loss but the size of the magnetic field needed to bend the energetic beam of particles into a circular path.

The maximum energy of the accelerator depends on the product of the size of the magnetic field and the radius of the circular path. CERN, in frugal European style, plans to put their new accelerator into the LEP tunnel with the LHC superconducting magnets positioned just above the smaller LEP magnets. The large LEP ring is well suited for a proton accelerator, but a much higher magnetic field than that used for LEP will be needed.

The LHC design depends on a major engineering breakthrough, the development of 10 Tesla dual-field superconducting magnet. To appreciate the magnitude of this engineering extrapolation, you must realize that the superconducting magnets used at FermiLab develop fields of about 3 Tesla. The SSC, which is under design at about the same time as the LHC, is using more conservative 6.6 Tesla single-field magnets. The stored energy in the magnetic field goes up as the square of the magnetic field strength, and engineering difficulty of producing the magnet probably increases as the cube of the field strength. Thus the LHC engineers are taking on a problem that is perhaps 3.5 times harder than the design of the SSC magnets.

There is also another major design difference between the SSC magnets and the LHC magnets. In the SSC, the magnets have a single cylindrical hole which contains the magnetic field and through which a beam passes. Because there are two beams (clockwise and counterclockwise) in the SSC, separate magnets are needed and the cost of magnets is doubled. There are, however, operational advantages in using separate magnets. For example, the two proton beams can have different energies, an operating mode that offers advantages for some physics applications.

The LHC magnets are more frugal with their magnetic flux, using it twice. The field lines are bent in a circle and pass through one beam cavity on the way up and another on the way down, providing magnetic deflection for the clockwise proton beam and the counter-

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clockwise proton beam within the same structure. Because the same field bends both beams, the magnets are both more compact and cheaper than the SSC magnets.

The LEP tunnel was constructed with expansion in mind and is roomy enough to house both LEP and LHC magnets. With 10 Tesla magnets bending the two particle beams in an 8.6 km diameter circle, the LHC will be able to bring pairs of protons into head-on collisions with a total collision energy of about 15.4 TeV (15.4×10^{12} electron volts), 8,200 times the mass-energy of the two protons at rest.

In contrast, the SSC, which will probably come into operation at Waxahachie a few years after the LHC, will produce collisions with energies 2.6 times larger than this. The SSC is designed to accelerate proton beams at 20 TeV per beam, so that the collision has 21,000 times the mass-energy of the colliding protons at rest.

These accelerator projects have common goals. The top quark, the heaviest and most elusive of the spin 1/2 particles, which has not yet been found, although groups at both CERN and FermiLab are now searching for it. It is known that the mass-energy of the top quark is not smaller than 90 GeV. This means that it is at least 19 times heavier than the heaviest of the known quarks, the bottom, which has a mass-energy of 4.7 GeV. It is possible that the top quark will have already been discovered when the LHC and SSC go into operation. However, as the time passes and experiments with higher precision and energy fail to find the top, it seems increasingly likely that its discovery must wait for the next generation of accelerators.

The Higgs boson is the other particle-in-waiting. Like the photon, the gluon, and the Z and W bosons, it is a mediating particle that is exchanged in an interaction. However, the interaction that characterizes the Higgs is not a force, like the electromagnetic, strong and weak forces that the other vector bosons mediate. It is the breaking of a symmetry between the forces. The standard model tells us that in regions of space where the energy density is sufficiently high, forces and particles become indistinguishable. Quarks and electrons, photons and Z^0s become identical in mass and interactions. As the region of space cools and the energy density drops, this symmetry breaks and the particles assume their familiar and distinctive characteristics. The mediating particle for this breaking of symmetry is the Higgs particle, and its mass sets the scale at which the symmetry-breaking transition occurs.

It is possible that there is only one Higgs particle (or that its role is assumed by a very heavy top-anti-top quark pair), but there may also be several Higgs particles with different masses. The Higgs must have a mass-energy of at least 90 GeV, or it would already have been observed experimentally. There are theoretical reasons for believing that the mass-energy of the lightest Higgs is less than 1 TeV. The 15.4 TeV collisions at the LHC, and the 40 TeV collisions at the SSC therefore provide an excellent chance of producing these particles.

There is also a third reason for building these accelerators, one that you will

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not find in the explicit justifications for the machine. It is a maxim in physics that if you look where no one has looked before, you may find what none has found before. The LHC and SSC will open up a new energy domain for exploration. There may be surprises and hidden aspects of nature there for the discovering, as there have been when other high energy accelerators made access to new domains of energy.

For most experimental physicists, working to test theoretical predictions, e.g., searching for the top quark and the Higgs, is what is done to keep busy while you are waiting for the *real* discovery, the breakthrough discovery that no one had even suspected. The standard model of particle physics works very well, and lately it has an unbroken string of successes in making testable predictions.

But the standard model is clearly incomplete. It has some 39 "adjustable" parameters—particle masses, force constants, and so on, which must have their basis in some deeper and more fundamental underlying aspects of nature. Most of the physicists who will be working at CERN and Waxahachie on the new accelerators will be there because the machines represent their best chance for digging deeper and perhaps discovering some of these. ■

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●Let no one tell me that silence gives consent, because whoever is silent dissents.

Maria Isabel Barreno

●To doubt everything and to believe everything are two equally convenient solutions; both dispense with the necessity of reflection.

Jules Henri Poincaré

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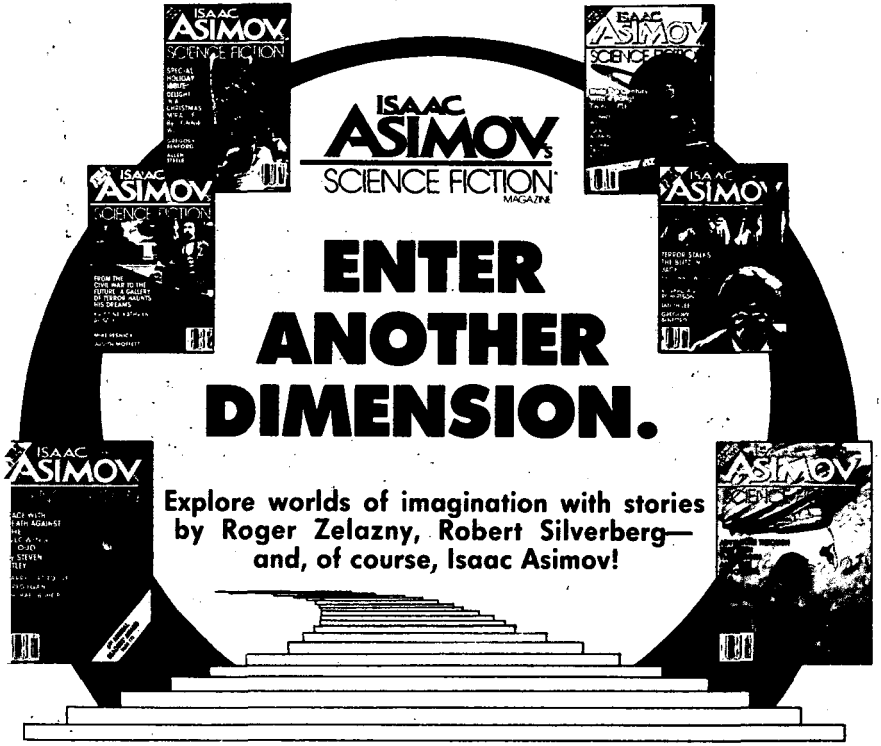
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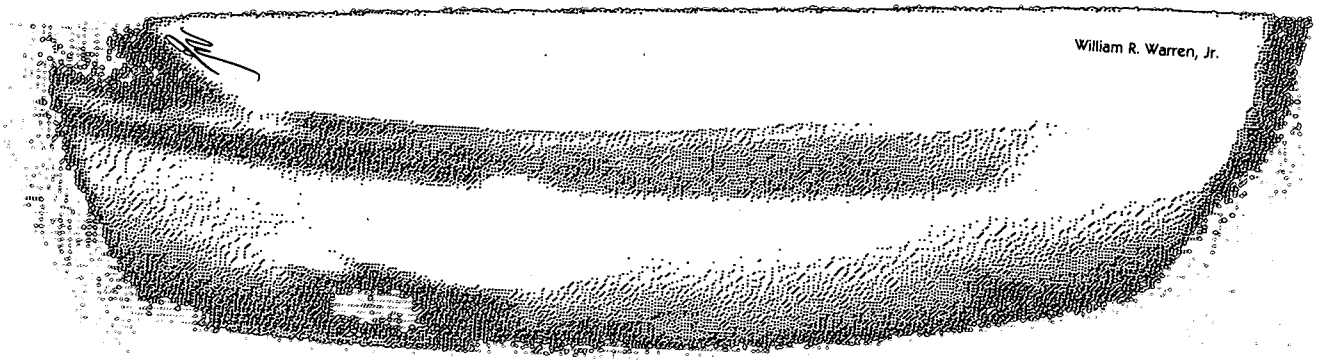

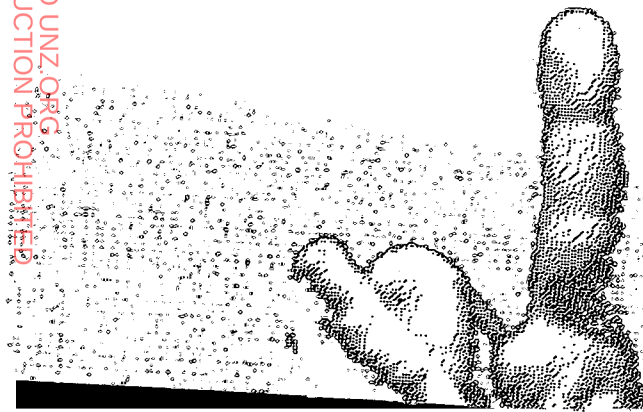

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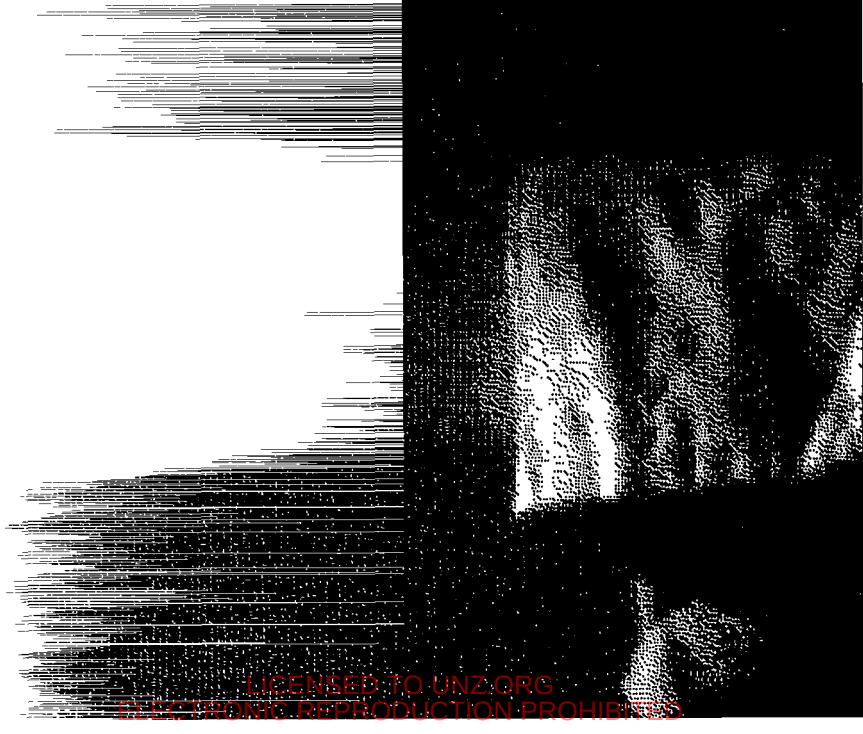
Doug Larsen

THE FUNDAMENTAL RIGHT

As times change, things like Constitutions get trickier and trickier to interpret. . . .



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I got the summons from the President himself.

"Collins, I'd like to see you and Freitag in my office."

My stomach knotted tight, but all I said was "Yessir," and then he hung up.

I hustled down the hall to where Freitag had his office. He was hanging up his phone.

"Was that him?" I asked. I felt strained even talking to him.

"That was him." Freitag got up, and we headed for the Oval Office together.

I was full of tension. "So this is it," I said. "The big decision. I wonder what he'll say."

"Me too," said Freitag. "I hope you haven't talked him into overthrowing the Constitution."

I didn't bother answering. We'd been through it too many times before. I wondered how things had deteriorated to the point that two friends could feel so tense around each other.

Freitag and I had been friends from way back. We'd started at the White House at about the same time, back when the President had started his first term in the year 2101. He and his wife had me over on the holidays. I even dated his sister when she came to Washington for visits.

The whole thing started as a joke over a year ago. Not his sister—I was getting kind of interested in her—I mean the idea. Freitag and I were at a bar getting pretty sloshed, and were watching a political commercial.

"Look at that clown," Freitag observed, refilling his glass. "He wants to be president. God help us."

I had to agree with him. I usually did, but this was easy. This campaign, with its warped rhetoric and grotesque posturing, was shaping up to be the stupidest yet.

"Do you realize," I asked, "that we'll be out of a job in two years? The President's second term is up then. What'll you do? Work for the next one?"

"I wouldn't work or vote for either of those idiots," Freitag said.

"Me neither."

Over the months that followed, we just developed the idea as a pleasant fantasy. It became an inside joke for those of us in the lower echelons of the White House. After a while, Freitag and I would argue the legalities of it, just for fun.

I have no idea how it happened, but somehow, the President heard of our idea. He called us up to the Oval Office to tell him about it. I was in there fairly often, but the place still had quite an effect on me every time. Part of it was the President himself. He was one of the few remaining politicians I respected any more.

We walked into the Oval Office, and I noticed that the President's chief advisors were there. The President waved us to a couple of chairs in front of his desk, sat down himself, and looked us over carefully.

"I see a couple of nervous guys in front of me," he concluded. He had this gravely jovial attitude I liked a lot. "Relax, both of you. I know this is something you've just thrown around for the fun of it. But sometimes, that's where good ideas come from. So fill me in."

Freitag and I looked at each other, and he signaled for me to start. I tried

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to collect my thoughts. "Well, sir, if it's OK with you, I think it's appropriate to recap what's happened in the current presidential campaign so far."

He made a face of distaste, but said, "If you must."

"Yessir. I'll try to be brief. Candidate A is ninety-seven years old. But after his nomination, he surgically altered his appearance so that he now looks like former President John F. Kennedy. His wife has been similarly altered so that she looks like Jacqueline Kennedy. His media campaign consists of a massive education effort to inform voters, with only occasional accuracy, what the country was like during the 1950s and 1960s. Apparently, that time period is his choice for the 'return to the good old days' approach."

The President nodded patiently.

I continued. "This coincides with a major merchandising effort he has initiated to sell memorabilia of the period in department stores. He has also instituted a major fashion trend toward 1960s clothing, and has altered the packaging on fast food items so that they resemble that of the 1960s." I paused for breath, and Freitag picked up the ball.

"Candidate A's speeches extol the virtue of those simpler, happier times. His commercials sometimes preempt the evening news, posing as news programs but broadcasting fact-based news of varying accuracy from the 1950s and 1960s."

"He's really going all-out to romanticize that era," I added.

The President sighed with exaggerated patience. "I'm familiar with all of this. Let's move on."

"Yessir," Freitag said. "Candidate B had herself surgically altered to look like Thomas Jefferson, and her husband to resemble the 1950s version of Betty Crocker. It's hard to pin down exactly, but she's picked an era around the early middle 1800s as her 'good old days' time frame.

"Instead of a media campaign, she's making personal appearances in the form of whistle stops. She's had an artificial train car fabricated, complete with ten miles of track, and she has the entire structure teleported from one location to the next."

I added, "She makes a speech, the train chugs off with great drama, and then it's teleported to the next stop. She's going to make a speech in almost every city."

"And her speeches are something else," Freitag said. "Her staff conducted a computer analysis of the speech and voice characteristics of Adolph Hitler. Her own speeches follow those characteristics, and are delivered in a synthesized Daniel Webster voice. The results are quite successful, resulting in crowds cheering her for hours."

I continued, "She's also contracted with Disney to erect huge, high technology movie-style backdrops in every major city to let the residents relate to the simpler, better times of the 1830s. These things come complete with music and costumed actors."

The President looked a little irritated. "I know all of this stuff, which doesn't make any of it any more palatable. And it's why I'm asking for details about your idea. But why is it necessary to go over it all again?"

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"Because it has a direct relation to our idea, sir," I said. "You'll notice that in all of our description, not a single issue came up?"

Freitag backed me up. "Not a single peep on the Mideast situation, energy policy, Spanish as the official language, Embryo Rights—nothing."

"So?" prompted the President with rising impatience.

"Our idea is this," I said. "Everyone is required by law to vote. And everyone votes on their own touch screen. So on election night, what if we made everyone answer an opinion poll before voting?"

"On what?" the President asked, starting to get interested.

I said, "We make them express their views on the issues of today, and form an accurate computer profile of what they believe. Then the computers compare each profile to the true opinions of both candidates. And if someone votes for Candidate A, for example, but agrees with Candidate B's position on the issues . . . " I took a deep breath again, "we switch the vote."

"You guys aren't boring, I'll say that for you," the President observed.

"Thank you, sir," I said noticing that Freitag was unusually silent. "I'm sure votes would be changed over to both candidates. It might even end up canceling each other out. But then, we'd never know."

"Why not?"

"Because we'd make sure there was no way to keep track of the switched votes, so that nobody could switch them back. We'd tell people that we switched their vote, but there would be no official record of who was switched—just a dialog box on the person's screen."

"But the people could say that their vote was switched," the President said.

"Who'd know if they were telling the truth?" I asked. "There'd be no accurate way to tell."

"And that's good?"

"Yessir. We don't want them to be able to just switch the votes back, but we do want individuals to know that they're being duped by the political machines. The only official record we want is the number of votes that were switched. What we end up with is an accurate representation of the views of the voting populace on where the country should go from here. A real vote, on the real issues!"

The President looked at Freitag. "Freitag, you've been awfully quiet. Why?"

Freitag looked uncomfortable. "I'm sorry, sir, but the fact is, we first came up with this idea in a bar. Since then, we've argued whether we could legally do it. And while Collins still likes it, I don't think there's any way we could justify it."

The President looked very interested. "Well, give me your arguments. And make it good."

Freitag and I looked at each other, and he gestured for me to start.

"Well," I said, "As we said, this all stems from the activities of the candidates in this election. The upshot is, the people have no basis on which to cast their votes."

"I'm the last person to defend those two clowns," Freitag said. "But face it. It's not their fault. The people have the power to insist on rational discus-

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sion of the issues, but they don't apply that power."

"Who cares whose fault it is?" I asked. "Look at the result. The democratic process is in a shambles."

He shook his head. "If you're looking for someone to defend the current political situation, you'll have to find somebody else. But the fact remains, you're talking about changing a vote that's been freely and deliberately cast. You can't do that."

"If the vote is freely and deliberately cast, but based on lies and deceit, how free is that vote?" I challenged.

"Completely free."

"But what is a vote supposed to be based on?" I objected. "Is it based on glitz and doubletalk? That's what we have now. Or is it supposed to be based on the deepset values and opinions of each voter? That's what we'll get with our plan."

He grimaced. "You can make it sound as pretty as you want. But a free vote, deliberately cast, is inviolate. People have the right to vote against their own best interests if they want to."

"Are you saying that *stupidity* is protected by the Constitution?"

"Absolutely!"

"Jesus!"

"Gentlemen," the President intervened. "Let's regain our dignity, shall we?"

"I'm sorry, sir, but it's true," Freitag said heatedly. "Face it. Liberals think conservatives are stupid. Conservatives think liberals are stupid. But if you're voting on your principles, who's to tell you that you can't do it?"

"You miss the point," I said, "What if you're conservative, but you end up voting for a liberal without even knowing it? That's what I mean by a stupid vote. You should be able to vote for what you believe. This questionnaire will make sure you do it."

"But you're placing restrictions on their freedom. You can't do that."

"Oh, come on," I said. "It's illegal for you to vote when you're drunk. And if you think you have the right to vote while drunk, that's too bad. The law just says that a sober vote is better than a drunk vote, and requires the former. I'm arguing for a law that says an informed vote is better than a stupid one."

"You can't set quality requirements for a vote," Freitag protested.

"Why not?" I retorted. "Citizens can be forced to act as jurors to support our judicial system. They can be drafted to defend our freedom. So what's wrong with making them vote the way they believe to defend democracy?"

There was a pause, and the President chuckled. "Well done, gentlemen. Now tell us about the legal precedents for your side."

Freitag looked at me. I made a generous gesture. "Go ahead," I said. "You first."

"Thanks." He cleared his throat. "OK. These are all Supreme Court rulings. *Louisiana v. the United States*, 1965, found that requiring voters to satisfy registrars of their ability to understand and give reasonable interpretation of the Constitution, violated the Constitution. *Wesberry v. Sanders*, 1964, found that the right to vote cannot be destroyed by alteration of ballots. *Herman v. Forssenius*, 1965, found that the right to vote is fundamental, and all

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other rights are illusory if the right to vote is undermined."

"Those are the 'race cases' of the 1960s, and they don't apply here," I objected. "Nobody's trying to prevent someone from voting. We're trying to make sure everyone votes the way they want."

"You'll get your chance, Collins," the President said. "Continue, Freitag."

Freitag grinned at me. "*Reynolds v. Sims*, 1964, held that the right of suffrage is a fundamental matter in a free and democratic society, and free and unimpaired voting is preservative of other basic civil and political rights."

There was an impressed silence. Finally, the President stirred. "Pretty thorough," he commented. "Collins? You're up. What do you have?"

I leaned back in my chair. "Ditto," I said.

The President looked at me. "I beg your pardon?" he asked finally.

"I cite every case Freitag cited," I said. "They all rule against infringement of the right of citizens to vote or express themselves. But the infringement is already taking place through the political machines. Our plan will protect and preserve our fundamental rights."

"No!" Freitag shouted. "You can't use my legal precedents to support changing votes!"

"They've already been changed!" I snapped. "We're changing them back."

"The votes weren't changed!" he shrilled. "The actual votes weren't tampered with!"

The President looked like a referee. "Calm down, both of you!"

We subsided, muttering apologies.

There was a lengthy silence in the room. I finally raised my hand, and the President nodded at me.

"I'd like to make an observation that Freitag would agree with," I said.

"I'd love to hear it," the President said.

"You're dealing with a very volatile issue," I said. "You tackle it, sir, and you're going to find yourself in the middle of a hurricane. Everything else you've ever done will disappear."

"I agree," Freitag said.

The President's chief of staff spoke up. "Mister President, you've had two good terms. History will be kind to you. Why take the chance on muddying yourself?"

The President looked at him coldly. "I like to think of myself as less craven than the standard politician," he said. "Freitag, Collins. If I do this, the election would be challenged, wouldn't it?"

We both nodded.

"By whom?"

"The loser would probably claim that they would have won if it had been conducted the standard way," I said. "Or someone who claimed their vote was changed."

"Obviously," Freitag added, "the case would have to be decided by the Supreme Court."

The President thought. "But the case wouldn't come to light until November 7th. And the new president has to take office January 20th. That's not much time for the case to move through the courts."

"If I may, sir," Freitag said "the case could be tried in a district court,

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and when the loser appeals, the Court of Appeals could certify the case for direct review by the Supreme Court."

"That would probably take too long," the President said.

"There's also original jurisdiction," Freitag said. "Article III, Section 2. The Supreme Court can hear cases where ambassadors and other public ministers are a party, and even has the power to hold jury trials. It would apply here."

"Original jurisdiction," the President mused. "I've never thought of that." He looked at us. "So would I win?"

Freitag shook his head as I nodded. The President looked daggers at us.

I smiled shakily. "It's a question of interpretation, sir," I said. "The Court will have to decide the true nature of a free vote. They'll have to determine the duties of citizenship in a free society."

Freitag nodded. "This will be the biggest case in decades. Maybe centuries. You're screwing with the basis of the Constitution."

"Or saving it," I added.

"Down, boys," the President said. "You've both stated your positions clearly. But the last time I checked, I was still president, so I get to decide. You may go now."

And after all of that, today was his big decision. Freitag and I were ushered into the Oval Office, still not talking to each other. The President gestured us to sit down. "I've made my decision," he said, "and I wanted you two to hear it first."

I wondered if I looked as tense as Freitag did. I sure felt like it.

The President looked at me. "I'm sorry, Collins. I just don't believe there's sufficient constitutional justification to do it."

Freitag breathed a loud sigh of relief. I sagged back in my chair in disappointment. "I see, sir," I said.

"I want to thank both of you," he said. "You both did your parts admirably. Now, I think it's best that we drop the subject, and get back to the job at hand. Freitag, you can go. Collins, I want an update on the trial in Chicago."

I stared at him blankly while Freitag left. The Chicago case seemed so trivial after what we'd been talking about. "Yes, sir," I muttered, trying to pull my wits together. "The case is nearing completion. It's looking like the prosecution has been able to—" the President gestured to me to stop when the door closed behind Freitag.

"Forget Chicago," he said. "You've got a lot of work to do. We're going ahead with your idea."

"We are!" I gasped, suddenly feeling very tense.

"Yes, we are. I don't want Freitag to know about it. Considering his feelings, I don't trust him to keep quiet about it."

"Yes, sir," I felt uncomfortable.

"I want you to engineer the whole thing, and report back to me. That doesn't just mean the election. That also means the case we'll present to the Supreme Court."

"But sir, if I may, what if we lose in the Supreme Court?"

He grinned. "Even if they invalidate the election, the new election would never be the same. There'd be so much controversy and media coverage that both candidates would be exposed. And, hopefully, people will be embar-

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rassed. It may shake them up enough to pay more attention from now on. So it would still do some good."

"But you'd lose."

"And the country would still win, at least a little. So I figure it's worth it."

I was impressed. You just didn't expect politicians to go around saying that kind of thing unless there was a TV camera nearby. "What made you decide to take the plunge?" I asked.

He looked very sober. "All my life, people have said that politicians are crooks, liars, and self-absorbed egomaniacs who are only interested in seeing how far they can spread their legs for the special interest groups. I never thought it was true. But now, seeing these clowns conducting their campaigns, it's made me ashamed to be a politician. They're the epitome of everything that's bad in American politics."

"True," I murmured.

"And then, one of my own advisors tells me not to get involved because it'll hurt my image. That's what decided it. Because I realized that that would be what most people would expect a politician to do—at least a two-faced, pabulum-spewing hypocrite like they're convinced all politicians are. And all along, I told myself I wasn't one of them. So now I get a chance to prove it—at least, to myself."

I was very impressed. I was almost afraid to ask my next question, but I had to. "Sir, do you think that Freitag is right? Are we violating the Constitution?"

The President looked sober. "I'm not trying to, which is more than I can say for some of my predecessors. I'm not going to cover anything up, or posture behind the flag. I'm just going to send it straight to the Supreme Court, and abide by their decision."

I took a chance, and grinned at him. "A president with balls," I said. "You're truly a rare breed."

For a second, I thought I'd gone too far. Then he leaned back in his chair, threw his head back, and laughed out loud.

I was pretty busy after that. I did a rough outline of the kind of questionnaire we needed, and had the public opinion people design it scientifically. I pulled in a few software people, and got them access to the Federal Election Commission's election computer banks. They had the system rigged in a few days. It was kind of alarming, how easy the whole thing was.

We had all been sworn to secrecy, so I felt safe in talking to them about it.

"What do you think about this?" I asked.

"Piece of cake," one of them responded. The others nodded.

"No, I mean, do you think it's a good thing? Should we be doing it?"

"Of course," one of them piped up. "The President told us to, didn't he?" The others nodded.

I missed Freitag.

Freitag and I had always done stuff together before this whole issue came up. We generally saw eye to eye. But now I had to avoid him because I didn't want him to know what I was doing. It really bothered me, because he avoided me, too. Maybe he thought I was mad at him because he thought his side had won.

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But there was nothing I could do about it until after the election.

Beyond the placid walls of the White House, the election was screaming along at a frenetic pace. Jefferson's actors in New York had foiled an attempted mugging, and they were playing it up for all they were worth. But one week before the election, Kennedy pulled his biggest ploy.

I was moping around my apartment. I missed Freitag. I wondered if I'd ever be able to date his sister again. I was watching something on prime time when it was interrupted by a carefully crafted "special report." An anchorman appeared on the screen, looking worried and grave. Behind him, old footage of 1963 was shown, and he announced that President Kennedy had been assassinated in Dallas.

I watched, my mouth open in disbelief.

They showed a clip of the real Jacqueline Kennedy, in mourning. They showed the real Kennedy's son, saluting at the gravesite. They showed people around the country reacting in grief, and played a sentimental montage of clips about the real Kennedy. Then the candidate "Kennedy" came on the screen.

"If you believe in John F. Kennedy," he intoned ardently, "please! Vote for me! *Bring me back to life!*"

"Jesus Christ!" I shrieked, throwing a book at the TV. "You filthy bastards!"

I returned to my work, filled with revolutionary zeal. This kind of garbage could not be allowed. I'd see to it!

I worked late on election night. Everything was ready, but I was pumped so full of adrenaline I couldn't even sit still. I decided to stay and vote from my office TV set. I turned it on. It didn't matter what channel I tuned in—they all carried the same program on election night.

"Welcome to Election Central," the anchorman intoned impressively. I listened impatiently through his "will of the people/democracy in action" speech. I wanted to get on with it. When registration came, I tapped the "standard registration" box, and pressed my right hand against the touch screen.

"Make sure your palm and all five fingers are making contact," the anchorman intoned. "Voters unable to use their right hands for standard registration should call up the "help" menu.

After a second, my TV beeped, and my name, address, and social security number came up on the screen. I tapped the "OK" box. Get on with it, get on with it.

The anchorman announced that there would be a change in the usual schedule, and my pulse quickened even more. He introduced the questionnaire, and he faded from the screen as the first question came up.

I recognized the questions, and had my answers ready. It took about fifteen minutes to complete the thing, and I made a mental note that it seemed like a long, tedious time. We'd have to make it easier, in future elections.

If we had the chance.

Finally, I finished all of the questions, and the form faded from the screen, accompanied by assurances that nobody but me would ever know any of the details of what I had just answered.

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I was offered the option of having my opinion profile printed out. I touched the "no" box. Then the ballot came up.

The candidates were arrayed before my eyes, with written and spoken instructions to vote for only one. With a feeling of grim cynicism, I tapped the box beside "No Choice." I had a low opinion of third-party candidates, and I was damned if I was going to vote for either of those two posturing fools that the two major parties had offered.

I waded through the rest of the ballots. They didn't matter to me. We had only rigged the presidential race with the opinion checker. I finished quickly, and watched with bitter irony as the election program faded from the screen. I checked my watch; it would be another half hour before the President was due to appear.

I looked around my office. I was as ready as possible. The shit was really going to hit the fan, now, and there wasn't anything I could do to stop it any more.

I wondered if I'd go to jail. It had never occurred to me before.

The President came right on schedule. He looked good; hopefully, he would look great compared to the two candidates in their clown suits. He gave a ten minute speech, announcing what he had done. The one piece of information that was new to me was that about 37% of the votes had been changed. Then he defended his actions. I smiled wryly as I recognized most of my arguments in his speech. He must have liked what I said.

The President had just signed off when I heard running footsteps in the hall. I braced myself. The door burst open, and Freitag stood there, breathing heavily. He was deathly pale, and sweating.

"You did it," he said in breathless disbelief. "You really went and did it."

"Listen—" I said.

"You bastard! You really did it! You fucked with the Constitution of the United States!"

"I know what your opinion is," I said. "You have to believe me. If I thought I was violating the Constitution, nothing in the world could have made me do it."

"I can't believe you did it," he said, staring at me. "You've destroyed the foundation of liberty."

This was starting to make me mad. "Listen, Freitag, I know how you feel. But you also know how I feel. And even though you're pissed off, deep down inside you know that I love the Constitution just as much as you do."

"I wonder," he said. "I wonder who you really are. I can't believe what you've done!"

"I haven't done anything!" I snapped. "If the Supreme Court doesn't like it, they'll punt it right back in our face. So you can stop acting like Joan of Arc!"

"I'm outta here," he said. "Tonight, I'm gonna find whoever is challenging this, and I'm going to work for them."

Even though I had braced for it, it was still worse than I thought it would be. "You know what the real tragedy is?" I asked. "I respect your views, but even though you know what my motivations are, you don't respect mine."

"That's right," he said. "I don't. I hope you rot in jail." He slammed my door, and was gone.

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* * *

The headlines in the *Washington Post* next morning probably hadn't been that big since Pearl Harbor. When I went to work, the White House was drowning under news trucks, parked ten deep outside. The two candidates were totally eclipsed by what we had done to them. Kennedy had won, but Jefferson was announcing that she would challenge the election in court. She, of course, was claiming that she would have won if the election had been normal. Kennedy didn't quite know what to say, so he was saying he'd have won either way.

I quit reading about them. They both made me sick. I turned to the analysis pages, to see what the breakdown had been. Apparently, 37 percent of the votes had been changed, but nobody had a record of whose votes had been affected, or if either candidate had lost more than the other. Those who had been changed were screaming bloody murder, but the analysis concluded that trying to correct things just by taking peoples' word for it was not going to be very successful—or truthful.

Kennedy had beaten Jefferson by five percentage points, but the big news was the "no choice" votes. Forty-three percent! That was the highest it had ever been since voting had become mandatory. Back in the Twentieth Century, sometimes more than half of the eligible voters hadn't voted, but since it had become required, it had dropped to around 15 or 20 percent picking the "no choice" option. But now, it seemed like a lot of people were disgusted at the antics of the two candidates.

I did some quick figuring. I knew that anybody who had picked "no choice" wouldn't have had their vote changed. So that left 57 percent of the voters, of whom 37 percent had their votes changed. Only 20 percent of the people who voted for someone had voted —either accidentally or deliberately—the way they actually believed!

I was digesting this information when I got buzzed.

"Mister Collins, the President would like you in his office right away."

"Thanks Ken, I'm on my way."

I hurried into the Oval Office, where the President was looking out the window. He turned when I came in. "Morning Collins, welcome to the hurricane."

"It's really something, sir," I said.

"You bet it is. You heard about Freitag?"

"Yessir. He told me last night that he was quitting."

"Well, he's going to be making headlines in the afternoon editions," the President said. "It's a shame—we could have used him."

"He'll be a tough opponent," I said.

The President looked keenly at me. "You ready to take him on?"

"Take him on, sir?"

He relaxed. "Then you don't know. I'll just start at the beginning. I called the Chief Justice last night, just before I made my speech. I told her that I placed myself at her disposal, and suggested that she convene the court. She reminded me that the judicial branch has the same amount of power under the Constitution as the executive branch, and that she didn't work for me." The President chuckled. "Presidents tend to forget that."

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I wisely said nothing.

The President continued. "But she thanked me for the advance notice, and assured me that if a challenge was brought, the court would be ready to hear the case and deliver a decision as soon as possible." He smiled again. "Even if I had forgotten about Original Jurisdiction, she sure hadn't. Not surprising, of course. She said she intended to invoke it immediately."

"So it's going straight to them," I said. It was a relief.

"Yep. I appointed three of them, which probably won't make a speck of difference in a case of this magnitude, but makes me feel a little less like I'm going into a lion's den. The only drawback now is that the opposition is going to need some time to organize. I hope it doesn't take too long. We need a president around here."

"Yessir. Of course, Freitag ought to speed up the opposition's organization. He already prepared most of it for our first debate in here."

He looked pensive. "That's a good point. I guess it's a good thing, although I miss having him around here."

So did I.

"But it'll speed things up," the President concluded. "So be sure you're ready."

"I will, sir," I said. "Who should I give my research to?"

"Keep it," he said.

"Sir?"

"Look, Collins, this goes far beyond any of us. This is going to have ramifications for our grandchildrens' grandchildren. So it has to be argued on the merits of the ideas involved."

"Yes, sir. So?"

"It's simple. If the polls are right, I've been fairly popular. I appointed three of the justices, like I said. I've been able to work on Capitol Hill. But it would be totally irresponsible to put my prestige to bear on our side."

"That's kind of unavoidable, isn't it, sir?"

"Yes and no. I want you to argue the case."

"Eeep!" I said.

He continued. "The attorney general will help you prepare, but I have instructed him not to appear in court. I will testify, of course, but I'm not going to politick for this thing until it's gone to the court. This has to be decided on constitutionality alone, not on political power or prestige."

I was shaking like a leaf. "You're hanging me out to dry, sir!"

"Not at all. I'm going to grant interviews, and put our arguments forth to the people. I'll be there in court. But I want you to carry the ball for me."

God help me now, I thought. But I only said, "Yes, sir."

I tried to look composed as I sat at a table in the Supreme Court chambers. I kept looking at the latest public opinion poll in the *Washington Post*, trying to get reassurance from it. Forty percent of those polled approved of the President's actions, with 43 percent opposing it and 17 percent undecided. It made me feel a little better, although with 43 percent voting "no choice," it shouldn't have been too surprising that we had some support.

I looked over at Freitag. He was sitting at the other table, looking stony. I knew that when he looked like that, he

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was nervous. He glanced over at me, then quickly looked away.

The President had been right about Freitag making headlines. When it came out that one of the President's aides, who had been involved in the plan from the start, had resigned out of protest, it had been splashed all over the media. Freitag had appeared everywhere, giving his reasons for opposing the action. Quickly, he became the leader of the opposition, representing a loose coalition of forces that banded together the week after election night. The losing political machine had joined; so had the American Civil Liberties Union—for different reasons, I was sure. I could tell that Freitag was more comfortable with the ACLU people than the political people.

They found a voter—Robert Morgan was his name—who said his vote had been changed, and filed the suit on his behalf. The President ordered me to send them all of the information we had, so they could get organized more quickly. "They'll file a paper to get it all anyway, so let's save some time," he said, mentioning his grandchildrens' grandchildren for about the millionth time.

As the controversy grew, the President stuck to his word, and refused to throw his personal popularity behind the action. Instead, he sent me.

Freitag and I saw a lot of each other as we squared off in the media, but none of it was much fun. He was on a personal crusade, and I guess I was, too. We didn't talk much, except to debate. I would lie awake at night, trying to anticipate his next move, his next angle, and try to be ready for it. And I'd think of phrases, techniques, anything that would give me an edge.

The President told me that it was the best debating matchup he'd seen in years. "You guys fight like tigers," he said. "And you rise to greater heights every time. But every time, it still comes out a draw."

I didn't say anything. I was tired, and I figured that my chances of another date with Freitag's sister were pretty much shot.

In a way, it was very sad. We used to be friends, so we fought fair. Freitag refused to extend the debate beyond the constitutional ideas involved. And when someone in an audience attacked me for trying to overthrow the government, Freitag would defend me. I appreciated it, because I got attacked more often than he did. But when someone accused Freitag of defending the ludicrous antics of the two candidates, I defended him, too.

It was all very civil, but it was sad because we used to be friends.

Presenting the case to the Supreme Court was very impressive. A small voice in the back of my mind kept telling me that I had really arrived. And I guess I had more faith in the judicial branch than I did in the legislative or executive branches. So it was impressive and reassuring. I came away feeling that whatever choice they made, it would be the right one.

But at the same time it was kind of boring. All of the briefs and motions had been filed. We had made the presentations hundreds of times, and there were few new questions. And there wasn't an audience out there screaming bloody murder. The arguments had dig-

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nity, assurance, and a feeling of control that took away some of the drama.

But by that time it was fine with me.

And then, suddenly, we were done.

Waiting took forever. It was an agony, especially since nobody had any idea how long it would take before the court reached a decision. The debate continued to rage in the newspapers. Television talk shows discussed nothing else. Town meetings flourished all over the country, and a few made headlines by ending in a brawl.

It all made me feel a little better. The President was right: the exposure, the controversy had shaken people up a lot. It would never be the same as it had been. Even if we lost, we had done some good.

The two candidates disappeared from sight in humiliation. Many commentators speculated that if the action were overturned and a new election was ordered, nobody was going to vote for those two clowns. A third party candidate, or a write-in candidate, would have the best chance in history.

The President, on the other hand, was everywhere. He gave hundreds of interviews, appeared in person all over the country, trying to be everywhere at once.

And, by God, I had to give him credit. He refused to appear anywhere, or give any interview, without a member of the opposition present and given equal time. "This goes beyond politics, Collins," he kept telling me. "This will affect our grandchildrens' grandchildren."

He was sincere, there was no doubt about it. And while opinion was still almost evenly split about what we had done, his personal popularity soared. The popularity of both candidates, meanwhile, went down the toilet.

The media, and the people, seemed insatiable. I had appeared in interviews on TV from coast to coast. It was quite a thrill, but none of them were as interesting, or as challenging, as the first debate when Freitag and I had gone head to head.

One day, about three weeks after the court appearance, I was sitting exhausted in my office. Staring at the wall, I brooded about everything that had happened. Waiting for the decision had strung me out.

The phone rang, making me jump. I grabbed it. "Collins," I said.

"How's it going?" a familiar voice asked, in the old, friendly way.

"Freitag!" I shouted. "How you doing?"

"I'm doing all right," he said. He paused. "Listen. You wanna meet me for a drink?"

"Sure. When?"

"How about now? In the National Press Club?"

"Meet you in ten minutes."

He bought the first round, and I bought the second before we started talking. "Listen," he said. "I'm sorry things got kind of out of hand."

"Hey, don't worry about it," I said. "I'm sorry too."

"The whole thing made me crazy for a while," he admitted. "I'm sorry about what I said at your office. I still think it's unconstitutional, but I know you don't. And I know you wouldn't have done it if you thought it was."

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"Thanks," I said. It meant a lot to me.

"I started calming down after we finished presenting the case," he said, pouring for both of us. "Taking it straight to the Supreme Court made me feel better. Showed me that you were still working within the system and not trying to overthrow it. It just took me a while to get up the nerve to say I wanna be friends again."

"So do I," I said, grabbing a drink. I wasn't comfortable with this stuff.

"Good," he said, looking relieved. "Now that we've got that out of the way, I've got some news. The court has made its decision."

"Really! When do we hear?" Adrenaline pumped through me again.

"It'll make the morning papers," Freitag said, smiling strangely. "But our side has an informant. We know some stuff."

I sputtered. "You know more than the White House?! That's humiliating! What do you know?"

"I know it was a five to four vote," Freitag said.

"Wow! Close one! What else?"

He took a deep breath. "And I know who won."

I grabbed him. "Who? *Who?!*"

"Guess," he instructed.

I shook him like a rat. "C'mon you bastard!"

He grinned, and then sobered as I released him. "Well, my side won. The election is invalidated, and a new one's been ordered."

"Bullshit!"

"Come on, Collins, you know I wouldn't lie about that."

That was true. I knew he wouldn't. I sagged back in my chair, and grabbed for my glass to cover my crushing disappointment.

Freitag clapped me on the shoulder. "Don't feel bad, pal. It couldn't have been any closer. And my source says that the dissenting opinion, the one in your favor, was just blistering. They figure it's going to be one of the most important dissenting opinions in history."

That's what they call small comfort. I was trying like hell to be a good sport about it, but this was really tough. After all of the work, after all the idealism. . . .

Freitag refilled our glasses in silent support, and looked behind us. Out of curiosity, I did too. A small group of people had formed, looking at us from a distance. After all, we were big names now, and our faces were familiar nationwide. They must have been surprised to see us drinking together.

"Well," Freitag said, "I have to admit I'm glad my side won, but now that it's over, I'm glad it happened. I'm glad you did it."

"Why?" I asked sullenly.

"Because the American public was taking its freedom for granted. They needed to be reminded how important it is, and your plan gave them one hell of a kick in the ass. Considering the uproar, there's no way any candidate is ever going to get away with the kind of crap Kennedy and Jefferson were pulling."

I nodded. That was true. "So what happens now?"

"I don't know a lot more about it," Freitag said. "There's going to be no criminal charges, but everybody knew that. And if you ask me, Kennedy and

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Jefferson don't stand a chance in a new election."

"So who does? A third party candidate?"

"Nah," Freitag said. "Both parties have honorable members. The President isn't the last of his kind, you know."

"Sometimes it seems close."

"True. But there's still a few out there. And they'll come forward, and get enough signatures to be put on the new ballots."

"But there's not enough time to have a campaign," I argued. I was feeling contrary.

Freitag laughed. "Who the hell needs two years to run an intelligent campaign? There'll be plenty of time for them to present their qualifications, and to tell people where they stand on the issues. What more do you need?"

"That about covers it," I admitted.

Freitag grinned. "So, even though you lost, you did a lot of good. And that's going to be my official comment tomorrow. Congratulations."

My grin was lopsided, but it was still a grin. Leave it to Freitag to help make me feel better.

"By the way," Freitag said, filling our glasses again. "My sister is coming to visit next week. She wants to know if you want to get together."

All of a sudden, I felt a lot better. I smiled broadly. "That would be great," I said. I toasted him, and we clinked glasses. Behind us, a camera's flash attachment went off.

The next day, the *New York Times* carried that picture on its front page. ■

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the reference library

By Tom Easton

Flying in Place, Susan Palwick, TOR, $16.95, 179 pp.
The Missing Matter, Thomas R. McDonough, Bantam, $4.99, 358 pp.
The Princes of the Air, John M. Ford, TOR, $3.99, 248 pp.
Escape from Loki, Philip Jose Farmer, Bantam, $4.50, 214 pp.
The Gallery of His Dreams, Kristine Kathryn Rusch, Axolotl Press (Pulphouse Publishing, Box 1227, Eugene, OR 97440), $10 trade paper, 80 pp.
The Best of Pulphouse: The Hardback Magazine, Kristine Kathryn Rusch, ed., St. Martin's, $22.95, 329 + xxii pp.
Universe 2, Robert Silverberg and Karen Haber, eds., Bantam, $21.50 (hb), $9.50 (tp), 397 + xvi pp.
Letters of the Alien Publisher, Charles C. Ryan and John Betancourt, eds., First Books (order from Ryan at P. O. Box 2449, Woburn, MA 01888 or Wildside Press, 37 Fillmore Street, Newark, NJ 07105), $25 (hb), $50 ("specially lettered"), 128 pp.
Books on Disk

Analog is a science fiction magazine. This column therefore focuses on science fiction books. *Analog* also covers science fact. So does this column from time to time. Because *Analog* does not include fantasy, this column ignores that genre of popular literature—except when it doesn't.

When doesn't it? I will occasionally review even very conventional yard goods, full of elves and dragons and wizards, just for a change of pace. Give me a book that breaks new ground or makes me laugh or astounds for sheer excellence of writing, and I will even push science fiction out of the column to make room for it.

If you think I should feel guilty for betraying your expectations, forget it. After all, most of you read fantasy too. And if a book has freshness and excellence enough to get me excited, you should read it even if you *hate* fantasy.

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Right?

So. Your assignment this month is Susan Palwick's **Flying in Place,** which is not SF at all. It's fantasy, though one could easily argue that the fantasy component is all in the protagonist's head, which makes it mainstream. But genre is irrelevant in this case. Palwick's short novel is one of those rare wads of marked-up paper with the power to move a jaded reviewer to tears.

You say that's not enough of a recommendation? Then here's the précis: The book opens with Bret's discovery of his wife's letters to her older sister, Ginny. He notes that Emma never met Ginny, who died before Emma was born. Yes, says Emma, I did meet her, doing cartwheels on my bedroom ceiling. Emma then proceeds to unfold for her husband the story of a surgeon father who comes to his daughter every dawn to do "the breathing" and leave bruises. Emma defends herself by leaving her body to float obliviously near the ceiling. The morning of Ginny's appearance is marked by bloody sheets.

Is Ginny real? Or a ghost? She tells Emma of things Emma had never known, such as the Aunt Donna who is never mentioned. She seems driven to help, to save her sister, but Emma will not listen. Like her mother, she cannot face the thought of what is happening to her. She wants only to flee, to fly with Ginny through the air, to dance with ghosts.

Bit by bit, the truth emerges. Ginny died because her only way to flee was not to eat. Emma's mother heaps her plate, criticizes the girl for not being as thin and pretty as Ginny, and refuses to see what is going on. Aunt Donna appears on the doorstep, and father is revealed as a vicious, manipulative bastard. Pressure mounts, and Emma's schoolwork suffers. She hides from her friend next door and that girl's mother, a sane and earthy woman who can see the truth and can encourage resistance and independence but is powerless to intervene until the screams begin.

The potency of this tale is such that if it did not begin by clearly signaling the happy ending, no one could stand to finish it. At the same time, it holds lessons for both the abused and those who see their pain, and it holds out hope that a better day may come—although that hope goes far too often unfulfilled.

So what are you waiting for?

Thomas R. McDonough's **The Missing Matter** is the latest in Byron Preiss Visual Publications's novel-essay combinations. Here the theme is dark matter, that component of the cosmos that does not shine by its own light (like stars) and hence can be sensed from Earth only by its gravitational effects. As Isaac Asimov explains in his introduction, human observers believe that the Universe is expanding from its initial Big Bang and will eventually, if it contains enough matter, contract back into a singularity, providing the whole shebang with a neat, nifty, and symmetric end. Unfortunately for symmetry, observers can account for no more than at most half the matter needed for "closure." The rest is missing. Yet there are signs—gravitational binding in and between galaxies—that much more matter is out there somewhere. It's just not observable. It's dark.

In the book's closing essay, space scientist Wallace H. Tucker covers the various alternative forms the missing matter might take, including axions, WIMPs, and neutrinos with mass. In the novel, McDonough offers something else entirely. Astronomer Tariq Salib, working in his Charon lab, notices what seems to be the spontaneous

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creation of matter, or the emergence of a white hole, or . . . He rushes down to the main research station on Pluto, meeting chief scientist Father Fitzpatrick (member of the Society of Jesuits for Allah—Islam runs the show, apparently thanks to a Protestant mind-hacker's long-past prank) and station chief Sybil Ollerenshaw, black, English, and the proud possessor of a robotic Sly Stallone with all the accessories. There he convinces Ollerenshaw that it is in the interests of her career to send the station's ramscoop spaceship off to investigate the anomaly.

And they're off, to find that the anomaly is now a life-bearing world, Ronin, with the annoying habit of popping out of one universe and into another every few hours. The universes vary in the sizes of various fundamental physical constants (e.g., Planck's constant), the apparent age of the Sun, and the chemistry of whatever lives on Earth. The result is a magical mystery tour of what reality might have been if physics were only a little different, and the book is quite fascinating on that level.

Unfortunately, there aren't any other levels. The characters are cardboard caricatures, and plot is virtually nonexistent. The tour proceeds from mystery to mystery until enough pages have accumulated. At that point the characters realize that recent increases in Planck's constant mean that they must be smarter (oddly, decreases in Planck's constant didn't seem to have much effect; maybe they were already as dumb as they could get). They promptly realize that Ronin is nothing more than an ordinary world whose "orbit" carries it perpendicular to all normal directions, across universes. They also realize that there must be a lot more Ronin-type material ("ronoids") out there, of all sizes down to dust grains, and that if they can just catch it and use it as reaction mass, they can drive their ship in the same strange direction. They *can* go home again. So they do. Almost.

To McDonough's credit, ronoids are an intriguing suggestion for solving the problem of the missing matter. The mass is out there, but it isn't observable because it's in another universe at the moment. But *The Missing Matter* does suffer as a novel. John Cramer did a much better job in *Twistor*, which used better characters and a much more vigorous plot to convey the suggestion of "shadow" matter.

John M. Ford gives us entertaining, intelligent adventure in **The Princes of the Air.** As the tale begins, three friends—Orden Obeck, an indentured student of diplomacy who dreams of serving the Queen of the fifteen worlds; David Koleman, who dreams of commanding a starship in the same Queen's service; and Theo Norne, who only wants to write a book of space-war tactics—are running a classic bait-and-switch con to raise money for the simulations that are their only experience of space flight and combat. News arrives that only a few of Obeck's class will leave the university world of Riyah Zain for the empire's capital. Will he be one of them? Of course, his friends assure him. They will go with him too, though first they will have to come up with a bigger con to raise the fare.

Not surprisingly, Obeck gains the coveted position, the con works—providing them with both cash and a satchel full of strange weaponry—and the trio is off on the road of dreams. Rising quickly in the diplomatic service, Obeck is soon in position to help his friends. Then, separately and together, they collect clues to a sinister, wide-

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spread plot against the Queen. Unfortunately, Obeck has compromised himself in the course of rescuing another diplomat and former teacher from rebel kidnappers, and when he tries to alert his superiors to the plot, no one listens. Only when it is almost too late does he get through to the Queen, and then . . .

I'm sure you recognize the pattern. Ford does deviate a bit, but the deviations don't hurt the tale at all. What does hurt, though perhaps not seriously, is that Ford has chosen to present a diplomatic corps obsessed with nuances of throat-clearing and such in a way that is familiar from numerous satires of diplomacy (e.g., Laumer's Retief stories). Yet Ford's tone is serious; he does not seem to be writing satire even though he is clearly using con games to comment on the duplicitousness of diplomacy. The seriousness is underlined—even as it is undercut by the mocking, satiric tone—by the way he uses quotes from the classics of political science. For me, the overall effect is to weaken the tale.

The first Doc Savage novel appeared in 1933, a part—like science fiction—of the wave of pulp fiction that inundated the newsstands before the age of television. It is therefore the reprints of later years that most of us recall as defining for us the epitome of pulp: heroes who had somehow developed both their brains and their muscles to the point where they could simultaneously outthink those demons of intellect who were constantly devising new and more fiendish ways to destroy white American civilization and outfight the monsters' muscle-bound thugs.

If you would like to taste the mix again—or even for the first time—here's your chance. The legendary man of bronze is back in "The First All-New Doc Savage Adventure Since 1949." It's **Escape from Loki,** by Philip Jose Farmer, and the flavor is very much as I recall it. It's also Doc's very first adventure, when at age sixteen he abandoned his physician father's program of physical and mental training to combat evil to fly a biplane for the French against the World War I Boche. Shot down, captured, escaped, captured, escaped, captured again and finally sent to the Loki POW camp, he finds a suitably fiendish Herr Doktor killing Russian POWs with biological experiments. Among the other POWs, he finds those wild and potent men who will be his companions in later adventures. In the end, they destroy the camp and escape. So, of course, does the Herr Doktor fiend to provide more villainy later on.

If you enjoy the tale, you can look forward to more. Bantam will follow it with Will Murray's *Python Isle*. Murray will be writing as Kenneth Robeson, a pseudonym used by Lester Dent on the early Savage tales. The story itself will be "an all-new adventure story based on a never-before published outline written by Lester Dent in 1935."

Kristine Kathryn Rusch is one of the founders of Pulphouse Publishing, a new magazine editor, and an up-and-coming writer (with a degree in history) who can make SF out of the life of Mathew Brady, the pioneering photographer who documented the Civil War on film and thereby began the process that has lead to the evening news and CNN.

According to Rusch's novella, **The Gallery of His Dreams,** Brady wanted to educate people about the gore of war in order to forestall any repeat of the carnage. He also dreamed of fame and was encouraged in that dream both by

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his wife Julia and by other dreams, in which a woman in clothing that seemed rather mannish for the nineteenth century (but not for the twentieth or twenty-first) showed him a gallery with his work on display and invited him to come with her to photograph other subjects. Eventually, once he had been driven into bankruptcy, he agreed and found himself recording with his primitive camera the slaughters of Hiroshima and My Lai and more.

The aggressor in each case seems to be the US, as if no other nation is quite so bloody-handed; this suggests an agenda for Brady's future patron that Rusch does not discuss. Yet she is quite explicit in contrasting Brady's vision of his work as the production of cautionary documents with the visions of his contemporaries, of his photographs of death and destruction as commercial commodities, and of his patron and the gallery visitors, of those photographs as art. Death as art. Rusch may be saying that when we lose sight of the pain and stink and loss inherent in death, seeing instead beauty in an arrangement of corpses, we become decadent. On the other hand, she leads us to think the pain and stink and loss are temporary. We may think we remember them, but what we recall is a cleaned up, arranged, polished version. Art, if you will.

And if what we remember and lay out in galleries and celebrate is so beautiful and glorious, then perhaps it is no wonder that we keep having wars.

Pulphouse: the Hardback Magazine is now gone, replaced by a slim biweekly. It made it through a dozen issues and was successful enough to fuel the expansion of Kristine Kathryn Rusch's and Dean Wesley Smith's publishing operation (Pulphouse) into a purveyor of novellas, short collections, bound short stories, pamphlets on writing, and more. The print runs tend to be small, and though they provide relatively economical product for the general public, they also provide more luxurious editions for the collector's market. What's more, the quality has been high enough to give Rusch a fine editorial reputation; together with her writing skills, that earned her the position of editor of *The Magazine of Fantasy and Science Fiction*, replacing Ed Ferman (who remains publisher).

So the flagship of the Pulphouse fleet has sunk, while the crew moves on to other things? Not quite. The biweekly bears the same name, and St. Martin's Press has brought out **The Best of Pulphouse: The Hardback Magazine.** This is an anthology of twenty-five stories, including such memorable items as Greg Egan's "The Moral Virologist," and Nina Kiriki Hoffman's "Savage Breasts" (which no other magazine would touch). Other contributors include Harlan Ellison, Charles de Lint, George Alec Effinger (the gruesome "Chopped Liver"), Jane Yolen, Robert Frazier, Lisa Goldstein, Harry Turtledove, Lisa Tuttle, Michael Swanwick, and Edward Bryant. There are also unknowns and first sales (Adam-Troy Castro's "Clearance to Land") that give no advantage to the luminaries.

In other words, good stuff, the best of a good series. Often outrageous and provocative. Always interesting. And available to many more of you than those small print runs could possibly reach.

Robert Silverberg and Karen Haber have produced the second issue of their successor to the late Terry Carr's seventeen-volume *Universe* series of anthologies of original stories. They've kept

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the name but restarted the numbering, so this one is **Universe 2.** The name is a very well deserved act of homage; the number, on the other hand, makes it awkward to talk of the two series as anything but the Carr-*Universe* and the Silverberg/Haber-*Universe*. They recognize the awkwardness but say, in effect, that the homage—the monument—is more important.

I won't argue. From the reader's point of view, after all, the title is practically irrelevant. You may remember Carr and his series fondly, but you'll buy this one for the stories.

You won't go too far wrong. For one thing, the book is considerably fatter than the Carr books. It's got more pages and more stories. And some of those stories are a fair match for anything Carr was able to publish. Sean McMullen's "Souls in the Great Machine" is a very satisfying treatment of the post-cataclysm rediscovery of computers, albeit with the chips replaced by human beings; the bite at the end underlines McMullen's concern with the subservience of humanity to its machines. Paula May's "Memories of Muriel" deals with aliens who imbibe the memories of the dead and with their impact on the aging businessman who comes searching for his lost love.

The book's twenty-one contributors include several newcomers to the field, but the old hands are there as well. There are Joe Haldeman, Brian Aldiss, John Gibbons, and Barry Malzberg, along with Kathe Koja, Lisa Mason, and more. Unfortunately, many of the contributors are less familiar than their material.

Interestingly, many of the stories praised by Silverberg and Haber as most "literary"—such as the two contributions by Alex Jeffers—strike me as both overwritten and pretentious.

* * *

I don't usually mention other SF magazines in this space. After all, it doesn't make much sense to give the competition a plug. But ever since its origin in 1986, *Aboriginal SF* has had a nifty gimmick: Editor Charles Ryan supposedly intercepted an alien anthropologist's reports home and ran them as essays by the magazine's "alien publisher." The alien's view was that of one bewildered by human folly and confused by human illogic, and the essays were quite entertaining. Now they are available as **Letters of the Alien Publisher,** edited by Charles C. Ryan and John Betancourt, from First Books, a joint venture of Ryan and Betancourt's Wildside Press. First Books will be doing "limited edition hardcovers, and some trade editions, of the first books of writers who make their first professional sale to *Aboriginal*." Later offerings will include Kris Rusch's *The White Mists of Power,* Robert A. Metzger's *Quad World,* and Patricia Anthony's *The Conscience of the Beagle.*

Books on Disk

The information I have suggests that the disk-top publishing movement isn't going places nearly as fast as its partisans wish. One such partisan with whom I'm familiar has offered material from established SF writers at reasonable prices and has gone to the expense of putting ads in a number of media in the SF (e.g., *Locus*) and computer fields. He has had plenty of queries and expressions of interest, but too few actual sales, to the point where he is now, as I write this, on the verge of saying, "The hell with it."

Why? There may be several factors at work. One is simply that most people seem to prefer to kick back with a paper book—its feel and heft and smell famil-

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iar since childhood—in their lap than to crouch over a flickering computer screen and keyboard. Another factor is that on-disk books aren't available in bookstores; you have to take some trouble to track them down. A third factor is the miserable quality of much of the product available. Last of all, people have been hearing about the Sony "diskman," a roughly book-sized device that will display on a screen text recorded on laser disks; it's useless with disk-top floppies, it lacks any way to download from a personal computer, and it will be in the country Real Soon Now. Maybe people are just waiting for it and its successors. When the genuine cyber-book arrives, Come the Millennium, disk-top publishing will explode.

Won't it? Well, maybe. If the market has not been irretrievably poisoned by the wads of unfiltered sludge floating around out there. And this is why I was rather alarmed by John Galuszka's comment that "As you have mentioned in your column, the number and quality of electronic publications is limited. To change this situation, I have killed off the rejection slip. Serendipity Systems will publish the next 100 manuscripts submitted to it."

That sounds rather toxic, doesn't it? You're used to seeing in books and magazines the end result of a careful screening process that rejects the vast bulk of submissions. Of that 100 submissions Galuszka will publish, this process *might* pass one (which is not to say that that one would be any good, mind you). One more might be as competently drafted but offend against too many sexual, political, religious, or other taboos to be acceptable. The rest? You don't want to see them. They're clumsy, awkward things, lacking in spelling, grammar, plot, and character. Some would simply say they stink.

Fortunately, Galuszka went into more detail in the full announcement in the fifth issue of his *Electronic Publishing Forum* (available on IBM-compatible 5.25″ disk for $5 from Serendipity Systems, P.O. Box 140, San Simeon, CA 93452). There are format requirements for submission, and there is a genuine attempt at quality control. Galuszka is *not* promising to distribute (sell) all 100 works of on-disk literary effort: "Those works which are not selected for distribution will be published in an edition of one copy." Distribution will then be up to the authors, whose main benefit must come from "publication," apparently meaning the mating of their work with Serendipity's new and much improved reader interface.

That new interface, by the way, is a good reason for having a look at *Forum #5*. It really is a great improvement. Another reason is a discussion of *An Electronic Holmes Companion*, which offers all of Sir Arthur Conan Doyle's Sherlock Holmes stories on 5.25″ or 3.5″ disks, for either IBM-compatibles or Macintoshes ($59.95 + $3 s&h from PsyLogic Systems, Box 315, Tolland, CT 06084); there is also a sample story ("The Five Orange Pips"). The article on interactive fiction (with a sample) is moderately interesting. The *Forum* also includes an abridged version of the Wordqwik grammar utility, which offers help in distinguishing such word pairs as forth/fourth and write/right.

As usual, the *Forum* lists electronic books in "print" from other publishers as well as Serendipity. The current version of the list seems a bit more selective than earlier ones; you could do worse than to use it as a buying guide.

Finally, Galuszka writes me that "Free copies of the *Forum* disk are no longer available. We will, however, ship *Analog* readers a *Forum* packet

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consisting of the current issue (*Forum #5*) and all back issues for just $10."

J. H. Kent Lyons recently sent me his "Electronic Bookstore" catalog (available from him at 209-633 Bucketwheel, Vancouver, BC, Canada V5Z 4A7; he also runs a computer bulletin board, "Harbinger," from 604-874-0265). If you like a book's capsule description and excerpts in the catalog; or if you like actual sample copies available at the UBC Bookstore in Vancouver, you place your order and he prints you a copy. The idea isn't entirely new since it has been used for years in the textbook industry (particularly for anthologies), where it was devised to handle the problem of supplying small demands. Modern computers mean that it is also an answer to the problem of maintaining expensive inventory. The main drawback is that you can't walk out of the store with your book until and unless the store sets up a computer and laser printer on site (which is expensive enough to wait until there is a lot of demand for a lot of short-run books). Another drawback—and he admits it right up front—is that the process "is a trial beginning" and "needs developing for commercial use, after a viable market . . . has been demonstrated." Sadly, modern marketing conditions seem to insist that a business get the bugs out first, or that "viable market" never appears.

Does Lyons have a chance to find that market? Most of the samples in the catalog didn't look all that impressive to me, but there were some exceptions, notably the poetry of Gerald S. Busch and other poets of the Harbinger Electronic Writers' Workshop (**Northern Light Verse . . . eh?**).

A different sort of thing is Sarah Smith's **King of Space**, from Eastgate Systems (P. O. Box 1307, Cambridge, MA 02238; 800-562-1638). The package I received was for the Macintosh, and apparently only for the Mac, so I couldn't check it out (my machine is IBM-compatible). But the brief manual does make it sound interesting. *King of Space* is a hypertext program that needs a hard disk, prefers two megabytes of memory, offers both artwork and music with the text, includes segments that allow the reader to participate in the story via simulations, and "contains scenes of sex and violence; please keep it away from children who use your computer."

Smith herself is a fan who has been involved with hypermedia since 1984, coedited the SF anthology *Future Boston* and authored a mainstream novel, *The Vanished Child*, coming in 1992 from Ballantine.

Smith, with her non-text, gamelike extras (art, music, simulations), may succeed better in the marketplace than the purveyors of pure-text disk-top products. Certainly Eastgate's descriptive copy makes me wish I had a Mac, or that the company made an MS-DOS version of the package.

But let's not fail to encourage Galuszka, Lyons, and their fellow toilers—including SF writers J. Neil Schulman (Softserv) and Steve Miller (BPLAN Virtuals)—in the computer-book vineyard. They're hanging in there even though the harvest seems long delayed. And I do think that harvest will come as soon as a booklike reader is widely and cheaply available. It could even come without that if someone would just put some marketing muscle into reaching the blind (many of whom "read" computer screens via speech synthesizers) and the physically handicapped. ■

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brass tacks

Dear Sir:

I enjoyed Mr. Anderson's article "Beating Warheads into Plowshares," (September 1991). Although it seemed to be written as history for your readers, I remember the newspaper and magazine articles that were published during that time.

One area that Mr. Anderson did not mention regarding the sea-level canal from the Pacific to the Caribbean Sea was the very great concerns about the intrusion of Pacific sea life into the Caribbean (especially the poison sea snakes, etc.). Of even more importance at the time, the little recognized fact that the Pacific Ocean's "sea level" is not the same as the Caribbean's (or Atlantic Ocean) "sea level." To quote the source ("Interoceanic Canal Studies 1970"; Atlantic-Pacific Interoceanic Canal Study Commission Washington, DC: USGPO, 1971), p. 60:

"The water level on the Pacific side, *twice each day, rises from 5 to 11 feet* above and falls 4 to 10 feet below that of the Atlantic side. A sea-level canal without tidal control structures would thus have strong currents that would change direction twice each day with the rise and fall of the tides."

The study went on to note that locks, to control the flow of water, would be necessary both to maintain the navigational depth in the proposed canal, and to reduce the current speed that ships using the canal would have to contend with if no tidal flow controls were built. Some of the "slow boats" (depending on their direction of transit) would not be able to move against the current during some phases of the tidal cycle.

The "sea-level" canal some place in Central America has been a dream for some time. Aside from politics and economics, a major obstacle has been that such a canal is not possible. The sea

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simply is not "level."

C. HENRY DEPEW

Tallahassee, FL

Dear Stanley:

I just finished reading your editorial "How-To," (September 1991) and find I strongly disagree with your arguments. I also think I have found one of the reasons why I have been losing interest in reading *Analog*. Though it is still one of the best, I feel it is losing ground.

If you really have so many manuscripts that you can not spend a minute or two writing something on at least most of them, then I would say that you have a job that is just too much for one person to do. It might be time to get more than one person reading and, whenever possible, helping the new writers. Because the point I have the strongest disagreement with is when you say your job is not to teach. Yes, it is your job to teach young writers what it is that is needed to be published in *Analog*. At least it is if you want *Analog* to remain the best science fiction monthly being printed.

Now I realize that there may be some money problems with more staff, but I think the readers will understand if you pass these along to them. I know I will pay more for better stories, but I will not pay less for worse.

What it all comes down to is that if you don't have the time to help new writers, if you don't have the time to get personally involved in helping new visions find a start, then you don't have time to publish Science Fiction.

PATRICK SPATZ

Sunnyvale, CA

Please reread the editorial—carefully. You missed some key points.

1: Writing something meaningful on most manuscripts is not*(!!!) a matter of "a minute or two."*

2: I did not *say my job is not to teach. I made it quite clear that teaching and helping new writers is a very important part of my job. However, it is not my job to teach* everybody. *Remember, we can only buy 1 or 2% of what we're offered. Why should we provide free private instruction to all, or even most, of the other 98%? In effect, you're saying that the readers, most of whom are not actively aspiring writers, should subsidize a large number of people who are not going to provide them with anything in return.*

My job is to find the relatively few who show clear promise of strengthening the magazine, and give them all the help I can. To do that, I want to personally read everything that comes in. Recognizing undeveloped talent is not *an easy thing that just anybody can do.*

Finally, I'm sorry to hear that you've been enjoying Analog *less lately, but the practices I described in "How-To" cannot be responsible for the change —because they're pretty much the same way things have been done for the entire history of the magazine.*

Subject: Coarse Language
Reference: "A Sweet Disorder," September 1991.

Is *Analog* trying to gain readers among the class that cannot express ideas in plain English? There is probably a market there, but is it worth driving off the other classes of readers?

Evidently Julia Ecklar's purpose is to use swear words to show how alienated the main character is. It comes off as an author's fascination with language heard at a rock concert or a hippie commune. What is surprising is that a magazine presumably aimed at scientifically literate readers would pass the bad language. Keep it up and some quotes from

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Analog will wind up in "Current Wisdom" in *The American Spectator*.

M. THORNTON

Seattle, WA

As I understand it, you're talking about approximately 10 words out of 6600—a far larger fraction than in any of Ms. Ecklar's other stories I've seen, but still very small. So much for the theory that she can't express ideas in plain English, is seeking readers among those who can't (I daresay that such readers wouldn't begin to understand her story), or is "fascinated" with such language per se.

Yes, those words here were a part of a characterization. No, I don't encourage writers to use them unless they have a definite reason to. But I will not *censor them when a writer has such a reason. I believe this was such a case; I'm sorry you disagree, but thank you for writing.*

What is surprising to me is your apparent belief that scientific literacy and a desire for censorship have anything at all to do with each other.

Dear Mr. Schmidt:

Thank you for including Mr. Sheffield's well-researched and well-argued essay on the Hubble Space Telescope "The Mote in NASA's Eye," in your October 1991 issue. I would like to add to that article the small and personal response of one who for a time played a tiny role in that large project, back in the days before the name Hubble was added to what I knew then simply and affectionately as Space Telescope.

I was pleased that Mr. Sheffield placed the blame for the Telescope's problem correctly: on a system of shared leadership that included what was then (and sadly still is now, I'm afraid) known ironically as "oversight." In my few years with Perkin-Elmer, I met a great many of the people who worked on the project, and I assure you that even amid the most frustrating of project times they did good, hard work on a project of which they were individually and collectively proud. And I can also assure you that none were more proud of their work than the team who polished the primary mirror. During the time they worked long hours polishing or waited long hours for the surface analyses that followed each round of polishing, if you or I were to have suggested they weren't making the best damn mirror anywhere we'd have gotten decked for our misstatement. . . .

. . . which, even in hindsight, it *was* in this sense: when photons struck that mirror's surface, a greater percentage were reflected (undistorted to within 1/65 wavelength in the direction *predicted by their test instrument*) than any mirror yet known to have been built.

I was privileged to have been able to direct some publicity pieces that included the videotaping of the polishing of the primary mirror and the still photography of the completed primary. To stand there in the clean room subsequent to the coating of the primary and look at the mirror was to see a 94-inch hole bored so cleanly, so completely from the background that I was surprised to see my front and not my back reflected in its surface. I'm here to assure you that, spherical aberration or not, this was a magnificent accomplishment by mere humans and their clever tools. I should also like to remind those who would cry "Two Billion Dollar Blunder!" of the following facts:

1. The cost of this magnificant primary mirror was a small fraction of that two billion total.

2. All members of the various project teams were pushing the state of the art

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forward, sometimes a little, sometimes a lot; this was a hell of an ambitious project, one that came within what can honestly be called a hair's breadth of total success.

3. Space is a very unforgiving place, maintenance-wise; if this problem had happened, say, on Mt. Wilson, it would have been fixed by now.

4. All is by no means lost; in time, the same ingenuity that was able to polish and coat so perfectly the (albeit incorrect) surface of the primary optic will devise a way to fix the telescope.

And call me an incurable romantic, but I believe that we *need* a telescope in space for the very same reason we *need* eyeglasses or opera glasses or backyard telescopes: to see what is around us (near or far) more clearly and more completely than we can with our unaided eyes . . . for the very same reason we will need telescopes on the Moon . . . and who knows? on Io, or around Betelgeuse, or . . .

The sky's the limit.

G. E. COGGSHALL

Allenhurst, NJ

Dear Stan,

Congratulations! I have just finished "Barrayar" and I can remember very few times since the original serialization of "Dune" when I had so much trouble putting a story down, or waited so anxiously for the next issue to arrive.

When you announced several months ago your intent to publish a prequel to the Miles Vorkosigan stories, I groaned. After all, stories should go forward, not backward, shouldn't they? Maybe in most cases they should, but this one has to be a notable exception. Kudos to you and Ms. Bujold.

After reading this story, however, I have two questions for Ms. Bujold:

1) I am a history buff, and if the Earth-origins of Barrayar are anything close to what I suspect, there should have been the strong influence or at least the presence of an organized church, but none was even mentioned in passing. Is there a Barrayar-historical reason for this, or would this have complicated the story line too much?

2) Your skillful allusions to events which preceded the start of this story have left me wanting a more complete picture of the political and social history prior to "Barrayar," especially the events which culminated in Aral and Cordelia becoming involved. A "prepre-quel" would probably be stretching it too much, but how about providing *Analog* readers with a synopsis starting with the colonization of Barrayar and including the "time of isolation," the various wars mentioned, Aral and Cordelia meeting, etc.?

Once again, congratulations on a great story, and I will be looking forward to the next installment in the continuing saga of Miles Vorkosigan.

JOHN C. FORTELKA

The author replies . . .

Thank you for your kind words! It seems to me that a lot of the so-called artistic limits of series format, and of genre fiction generally, are self-inflicted. It's been one of my aims to push those limits, not outward, deforming the form, but inward, to depth and complexity. *Barrayar* represents perhaps my most ornery effort in this direction so far. (After all—who else writes about the hero's *mother*? Darn few.)

Re: question #1. Barrayar does not suffer from a state church; as for religion in its society, religions may be presumed to be out there, less influential than average, but they simply haven't come into the orbit of one of my tales yet. Same goes for industry, which is surely heavily implied (where do read-

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ers think all those aircars are coming from?) but except for a brief mention of industrial air pollution in Vorbarr Sultana, just hasn't occasion to take center stage. My attitude toward my backgrounds and settings tends to be rather cavalier, compared to some meticulous world-builders. Character takes the center for me, action supports it (with theme as the check-template), and setting comes last, "got up" to support the story in question. Naturally, it all fits at the end. There is undoubtedly a Barrayaran-historical reason for everything, and if that thing comes as possible, except for the broad outline, in part so I can reserve the right to have a better idea later, as my own education improves. Which leads us to . . .

Your item #2. As for the synopsis, a general outline exists in my head, with some details, but I'm not going to commit it to paper till I'm actually working on a story, and have the concentrated attention to do it right. However, I'd like to mention that *"Barrayar" is* a sequel, to my very first novel *Shards of Honor*. I had been very concerned that *Barrayar* stand alone as a complete novel, a whole, and the preliminary feedback I've had seems to indicate I succeeded. (Stan bought it, for one thing.) But *Barrayar* is more than a sequel, it's literally the other half of the original story I conceived in 1982, which began with Aral and Cordelia's first meeting in extreme circumstances and which, originally, I'd intended to end with Miles's birth. About a hundred pages of what is now the opening third of *Barrayar* were written then—I won't tell you which hundred. Marketing considerations led me to cut the story short, and go on to write *The Warrior's Apprentice*, the book where Miles got his start, which most readers of WA will probably agree was the right thing to do. Then. Eight years later, with six more novels under my belt and a much more profound understanding of my theme, I was at last ready to do *Barrayar* right, so I did. *Shards of Honor* is being rereleased this fall from Baen Books along with *Barrayar* and should be generally available. So your requested "pre-prequel" already exists. As for Prince Xav's adventures, and the Cetagandan invasion, and all that —well, maybe someday.

LOIS McMASTER BUJOLD

Dear Dr. Schmidt and Company,

From time to time, someone writes in to comment on how closely one of your fiction pieces parallels current events at the time of publication. Perhaps you just set a record.

Barrayar, a superior serial by Lois McMaster Bujold, is the story of a land that has been under repressive and autocratic rule for much longer than anyone can remember. Just lately, enlightened leaders have been trying to reconstruct it into a more free and open society. This, of course, incurs the ire and enmity of the old guard, who see their powers and privileges disappearing. They plan a coup, an essential part of which includes the kidnapping of the head of state with close members of his family. This does not come off quite as intended, so they try to represent that the head of state is indefinitely unavailable, and that they, the conservatives, are needed as provisional government—or, not so provisional.

However, they do not receive the degree of support, either from the populace, or from other leaders, that they had been counting on. (Or maybe the whole thing was, and was known to be, a wild and desperate gamble from the start.) Some important people either rally to the support of the ousted gov-

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ernment, or lie low and support no one. Some military personnel desert their regiments, rather than take orders from the officers who support the new/old rulers; some regiments line up with the resisters. Eventually, the forces of enlightenment and reform prevail completely; the reactionaries are far worse off, having hastened just about everything that they tried to prevent. People who gave them even token support, or who lay low and were neutral have a lot of futile explaining to do, and some would rather face death.

Now, all of that sounds *remarkably* like certain things that have been happening August 18 - 25 1991 in Soviet Russia. Confess! Somebody on your staff—or Bujold herself—has discovered Precognition! How long before the FBI comes around to ask questions?

EDITH S. TYSON
Warren, OH ■

●Man will never reach the Moon regardless of all future scientific advances.

Dr. Lee DeForest, quoted in the *New York Times*, February 25, 1957.

●Travel is fatal to prejudice, bigotry, and narrow-mindedness, and many of our people need it sorely. . . . Broad, wholesome, charitable views . . . cannot be acquired by vegetating in one's little corner of the earth.

Mark Twain

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a calendar of analog upcoming events

1-3 May
PHOENIXCON/DeepSouthCon 30 (DeepSouth SF conference) at Atlanta, Ga. Guest of Honor—Joe R. Lansdale, Artist Guest of Honor—Alan M. Clark, Fan Guest of Honor—Marilyn Teague, TM—Charles L. Grant. Registration—$25 until 15 April, $30 thereafter. Info: DeepSouthCon 30, 1579-F Monroe Drive, #218, Atlanta GA 30324.

1-3 May
ROC*KON (Little Rock area SF conference) at Excelsior Hotel, Little Rock, Ark. Guest of Honor—Lois McMaster Bujold, Artist Guest of Honor—Cat Conrad, Storyteller—Fran Stallings. Registration—$15 until 31 April, $20 at the door. Info: RocKon 16, Box 24285, Little Rock AR 72221 (include SASE). (501) 370-0889; GEnie C.BOYD1; CompuServe 72676, 3536.

15-17 May
CONduit 2—Son of CONduit at Quality Inn, Salt Lake City, Utah. Guest of Honor—Roger Zelazny, Gaming Guest of Honor—Mike Stackpole, Artist Guest of Honor—Liz Danforth, other confirmed guests: Dave Wolverton and M. Shayne Bell. Registration: $18 until 29 February, $20 until 30 April, $24 at the door. Info: 2566 Blaine Ave., Salt Lake City UT 84108-3359. (801) 467-9517.

15-17 May
KUBLA KHAN 20 (Tennessee SF conference) at Ramada Inn South, Nashville, Tenn. Guest of Honor—Frederik Pohl, Fan Guests of Honor—Jim & Doreen Webbert, Artist Guest of Honor—Paul Lehr, MC—Andrew J. Offutt. Registration—$20 until 15 April, $25 thereafter. Info: Ken Moore, 647 Devon Dr., Nashville TN 37220. (615) 832-8402.

15-17 May
OASIS V (Florida SF conference) at Ramada Inn, Altamonte, Fla. Guest of Honor—Michael Bishop, Artist Guest of Honor—Holly Bird, Fan Guests of Honor—Ann & Kendall Morris, Special Guest—Andre Norton. Registration—$17 until 15 April, $20 at the door. Info: OASFiS, Box 940992, Maitland FL 32794-0992.

23-26 May
92nd A.B.A. Convention and Exhibition at the Hilton, Marriott and Convention Center, Anaheim, Calif. Open to the trade only. Info: American Booksellers Association, 137 West 25th St., New York NY 10001.

3-7 September
MAGICON (50th World Science Fiction Convention) at Orange County Civic & Convention Center, Orlando, Fla. Guest of Honor—Jack Vance; Artist Guest of Honor—Vincent Di Fate; Fan Guest of Honor—Walter A. Willis. Registration—$110 adult/$55 child until 15 July 1992; $135 adult/$75 child at the door, Supporting—$25. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: MagiCon, Box 621992, Orlando FL 32862-1992. (407) 275-0027. UK agent Peter Weston, 72 Beeches Drive, Erdington, Birmingham B24 0DT UK.

29 October-1 November
WORLD FANTASY CONVENTION at Callaway Gardens, Pine Mountain, Ga. Limited membership. Registration—$100 in advance. Info: World Fantasy Convention 92, Box 148, Clarkston GA 30021. (include SASE)

—Anthony Lewis

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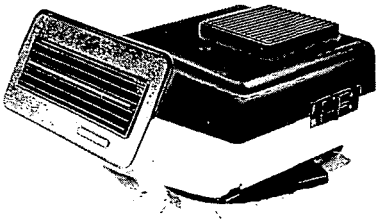

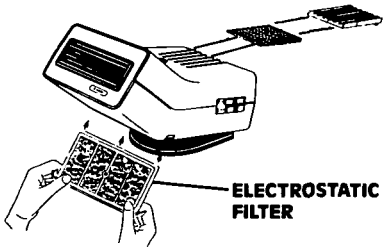

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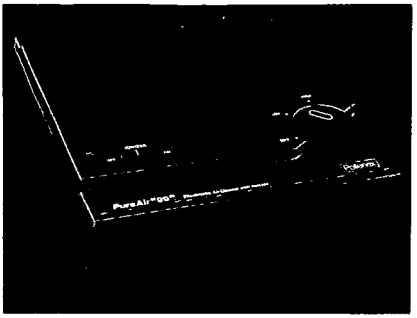
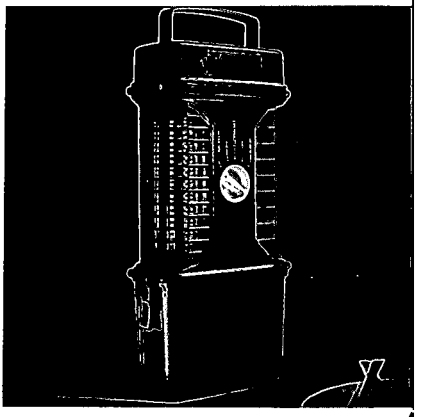
▼ FRESH AIR



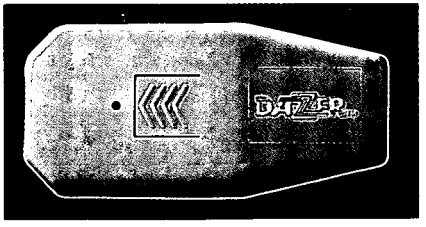
Concern about air pollution is on the rise. The Pollenex® Pure Air "99" Air Cleaner with Ionizer will help clear the air around you. A high voltage generator produces negative ions that help reduce minute particles of dust, tobacco smoke and other airborne pollutants. An electrostatic air filter intercepts larger airborne particles and has a deodorizing action too. Two speed air flow control. So now you can breathe easier with Pure Air "99". **$69.98** ($7.50) #A1962; 2 for **$125.98** ($10.00) #1962/2

► D-BUG LIGHT



Don't let flying pests spoil your next outdoor activity. Just bring along the D-Bug Light, electronic bug killer lantern. More than just a great bug zapper, this unit combines the zapper with a fluorescent lantern and a safety blinker. Portable and easy to carry with its own handle, the D-Bug Light is made of high impact durable plastic. Uses two 6 volt batteries (not inc.) 12 volt DC receptacle adapts to car, RV or boat battery, so its great for camping, boating, picnics, backyards. So don't let bugs spoil your outdoor fun—just "de-bug"! **$59.98** ($5.00) #A1964.

▼ THE DAZER™



Even the most dedicated canine aficionado can sometimes encounter unfriendly dogs. Dazer™ provides a humane way to repel their advance, emitting ultrasonic sound waves inaudible to humans and totally safe for dogs (unlike mace and other common deterrents). Pocket size (4¾" long) plastic case can also clip on belt; takes 1-9V battery, included. For joggers, hikers, bikers, seniors and kids—plus the proverbial postman. **$29.98**, ($3.00) #A1829X.

TO ORDER: Send check with item number for total amounts, plus shipping & handling shown in ( ) payable to **MAIL ORDER MALL**, Dept. 052 AN, P.O. Box 3006, Lakewood, N.J. 08701, or call TOLL FREE **1-800-722-9999.** NJ residents add 6% sales tax. We honor MasterCard/Visa. Sorry, no Canadian, foreign, or C.O.D. orders. Satisfaction Guaranteed. 30 day money back guarantee for exchange or refund. Allow 30 days for delivery.

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